DOE/EIS-0229

Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement

Summary

United States Department of Energy
Office of Fissile Materials Disposition

Tt-575-EIS-229-DS

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LIST OF ACRONYMS AND ABBREVIATIONS

ANL-W	Argonne National Laboratory-West
APSF	Actinide Packaging and Storage Facility
ARIES	Advanced Recovery and Integrated Extraction System
BWR	boiling water reactor
CANDU	Canadian Deuterium Uranium
DNFSB	Defense Nuclear Facilities Safety Board
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DWPF	Defense Waste Processing Facility
EIS	environmental impact statement
ESA	*Endangered Species Act*
ES&H	environmental, safety, and health
FFTF	Fast Flux Test Facility
FMF	Fuel Manufacturing Facility
FONSI	Finding of No Significant Impact
GBZ	glass-bonded zeolite
Hanford	Hanford Site
HEU	highly enriched uranium
HEU EIS	*Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*
HLW	high-level waste
ICPP	Idaho Chemical Processing Plant
IMNM EIS	*Environmental Impact Statement, Interim Management of Nuclear Materials*
INEL	Idaho National Engineering Laboratory
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LLW	low-level waste
LWR	light water reactor
MEI	maximally exposed individual
MOX	mixed oxide
NEPA	*National Environmental Policy Act* of 1969
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System

NRHP	National Register of Historic Places
NTS	Nevada Test Site
NWPA	*Nuclear Waste Policy Act*
ORR	Oak Ridge Reservation
Pantex	Pantex Plant
PEIS	programmatic environmental impact statement
PFP	Plutonium Finishing Plant
PRA	Probabilistic Risk Assessment
PSD	Prevention of Significant Deterioration
PWR	pressurized water reactor
R&D	Research and Development
RCRA	*Resource Conservation and Recovery Act*
REA	regional economic area
RFETS	Rocky Flats Environmental Technology Site
ROD	Record of Decision
ROI	region of influence
RWMC	Radioactive Waste Management Complex
RWMS	Radioactive Waste Management Site
SRS	Savannah River Site
Stockpile Stewardship and Management PEIS	*Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*
Storage and Disposition PEIS	*Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*
TRU	transuranic
TSP	total suspended particulates
TSR PEIS	*Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling*
VRM	Visual Resource Management
WIPP	Waste Isolation Pilot Plant
WSA	Weapons Storage Area
Y–12	Y–12 Plant
Y–12 EA	*Environmental Assessment for the Proposed Interim Storage of Highly Enriched Uranium Above the Maximum Historical Storage Level at the Y-12 Plant*
ZPPR	Zero Power Physics Reactor

Chemicals and Units of Measure

cm	centimeter
Cs	cesium
Cs-137	cesium-137
CsCl	cesium chloride
gal	gallon
ha	hectare
H_2O	hydrogen oxide, or (light) water
in	inch
kg	kilogram
km	kilometer
l	liter
lb	pound
m^3	cubic meter
mi	mile
MLY	million liters per year
mrem	millirems
PM_{10}	particulate matter less than or equal to 10 microns in diameter
Pu	plutonium
Pu-238	plutonium-238
Pu-242	plutonium-242
PuO_2	plutonium dioxide
t	metric ton
tons	short tons
UO_2	uranium dioxide
yd^3	cubic yards
yr	year

METRIC CONVERSION CHART

To Convert Into Metric			To Convert Out of Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
sq. inches	6.4516	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.092903	sq. meters	sq. meters	10.7639	sq. feet
sq. yards	0.8361	sq. meters	sq. meters	1.196	sq. yards
acres	0.40469	hectares	hectares	2.471	acres
sq. miles	2.58999	sq. kilometers	sq. kilometers	0.3861	sq. miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.45360	kilograms	kilograms	2.2046	pounds
short tons	0.90718	metric tons	metric tons	1.1023	short tons
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths, then add 32	Fahrenheit

METRIC PREFIXES

Prefix	Symbol	Multiplication Factor
exa-	E	1 000 000 000 000 000 000 = 10^{18}
peta-	P	1 000 000 000 000 000 = 10^{15}
tera-	T	1 000 000 000 000 = 10^{12}
giga-	G	1 000 000 000 = 10^{9}
mega-	M	1 000 000 = 10^{6}
kilo-	k	1 000 = 10^{3}
hecto-	h	100 = 10^{2}
deka-	da	10 = 10^{1}
deci-	d	0.1 = 10^{-1}
centi-	c	0.01 = 10^{-2}
milli-	m	0.001 = 10^{-3}
micro-	µ	0.000 001 = 10^{-6}
nano-	n	0.000 000 001 = 10^{-9}
pico-	p	0.000 000 000 001 = 10^{-12}
femto-	f	0.000 000 000 000 001 = 10^{-15}
atto-	a	0.000 000 000 000 000 001 = 10^{-18}

Summary

S.1 INTRODUCTION

The end of the Cold War created a legacy of weapons-usable fissile materials both in the United States and the former Soviet Union. Substantial quantities of these materials, including plutonium (Pu) and highly enriched uranium (HEU), are no longer needed for defense purposes. Further agreements on disarmament between the United States and Russia may increase the surplus quantities of these materials. The global stockpiles of weapons-usable fissile materials pose a danger to national and international security in the form of potential proliferation of nuclear weapons and potential environmental, safety, and health consequences if the materials are not properly safeguarded and managed.

In September 1993, President Clinton issued the *Nonproliferation and Export Control Policy* in response to the growing threat of nuclear weapons proliferation. Further, in January 1994, President Clinton and Russia's President Yeltsin issued a *Joint Statement Between the United States and Russia on Nonproliferation of Weapons of Mass Destruction and Means of their Delivery*. In accordance with these policies, the focus of the U.S. nonproliferation efforts in this regard is five-fold: to secure nuclear materials in the former Soviet Union; to ensure safe, secure, long-term storage and disposition of surplus fissile materials; to establish transparent and irreversible nuclear reductions; to strengthen the nuclear nonproliferation regime; and to control nuclear exports.

To demonstrate the U.S. commitment to these objectives, the President announced on March 1, 1995, that 200 metric tons (t) (220 short tons [tons]) of U.S. fissile materials, 38.2 t (42.1 tons) of which is weapons-grade Pu (as stated in the Department of Energy's [DOE's] Openness Initiative of February 6, 1996), had been declared surplus to the U.S. nuclear defense needs. The United States is proceeding with plans and actions to ensure the continued safe, secure, and environmentally sound storage of its own weapons-usable fissile materials and is cooperating with Russia in an effort to reduce the risk of nuclear weapons proliferation. Additionally, DOE and its national laboratories have recently completed a joint study with Russia on technical options for the disposition of weapons-usable Pu.

Weapons-Usable Fissile Materials
(Covered in the Programmatic Environmental Impact Statement)

All isotopes of Pu (except plutonium-238 [Pu-238]) and HEU that contain at least 20 percent uranium-235.[1]

A key element of DOE's decisionmaking is a thorough understanding of the environmental impacts that may occur during the implementation of the proposed action. The *National Environmental Policy Act* of 1969 (NEPA), as amended, requires Federal agencies to prepare an environmental impact statement (EIS) on all major Federal actions significantly affecting the quality of the human environment. In following this process, DOE has prepared the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement* (Storage and Disposition PEIS) to analyze various storage and disposition alternatives and to provide the necessary background, data, and analyses to help decisionmakers and the public understand the potential environmental impacts of each alternative. The results of the environmental analyses, together with information from technical and economic studies, nonproliferation analysis, and public input, will form the basis for DOE's decisions, which will be given in a Record of Decision (ROD) to be issued no sooner than

[1] Does not include spent nuclear fuel, irradiated targets, uranium-233, or Department of Defense (DoD) weapons program material in use.

30 days after publication of the Environmental Protection Agency's Notice of Availability of the Final PEIS. This process will also provide the United States with the basis and flexibility to implement Pu disposition efforts either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

THE PROPOSED ACTION

The Department proposes to take the following actions for U.S. weapons-usable fissile materials:

- Storage—provide a long-term storage system (for up to 50 years) for nonsurplus Pu and HEU that meets the Stored Weapons Standard[2] and applicable environmental, safety, and health standards while reducing storage and infrastructure[3] costs

> *Stored Weapons Standard*
>
> The high standards of security and accounting for the storage of intact nuclear weapons should be maintained, to the extent practical, for weapons-usable fissile materials throughout dismantlement, storage, and disposition.

- Storage Pending Disposition—provide storage that meets the Stored Weapons Standard for inventories of weapons-usable Pu and HEU[4] that have been or may be declared surplus
- Disposition[5]—convert surplus Pu and Pu that may be declared surplus in the future to forms that meet the Spent Fuel Standard,[2] thereby providing evidence of irreversible disarmament and setting a model for proliferation resistance

> *Spent Fuel Standard*
>
> The surplus weapons-usable Pu should be made as inaccessible and unattractive for weapons use as the much larger and growing quantity of Pu that exists in spent nuclear fuel from commercial power reactors.

The Department's inventories of Pu and HEU are located at a number of DOE sites, including Hanford Site (Hanford), Idaho National Engineering Laboratory (INEL), Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), Oak Ridge Reservation (ORR), Pantex Plant (Pantex), Rocky Flats Environmental Technology Site (RFETS), and Savannah River Site (SRS). These weapons-usable fissile materials are divided into two categories: surplus and nonsurplus. Surplus materials include those the President

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2 Modified from *Management and Disposition of Excess Weapons Plutonium*, National Academy of Sciences, 1994.
3 Includes electrical power, fuel, transportation network requirements, and safeguards/security.
4 The Storage and Disposition PEIS covers long-term storage of nonsurplus HEU and storage of surplus HEU pending disposition. Until storage decisions are implemented, surplus HEU that has not gone to disposition will continue to be stored pursuant to, and not to exceed the 10-year interim storage time period evaluated in the *Environmental Assessment for the Proposed Interim Storage of Enriched Uranium Above the Maximum Historical Storage Level at the Y–12 Plant, Oak Ridge, Tennessee* (Y–12 EA) (DOE/EA-0929, September 1994) and Finding of No Significant Impact (FONSI).
5 Disposition of surplus HEU is addressed in a separate document, the *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (DOE/EIS-0240, June 1996).

has declared surplus to national defense needs in response to recommendations from the Nuclear Weapons Council (made up of representatives from DOE, the DoD, and the Joint Chiefs of Staff) and those that may be declared surplus in the future. The nonsurplus materials include naval nuclear fuel, strategic reserves, programmatic materials (non-weapons research and development [R&D], weapons R&D, and other programmatic materials), and weapons program materials in use, as shown in Figure S.1–1. Weapons program materials in use are not within the scope of the PEIS. The forms of the weapons-usable fissile materials are primarily pits and secondaries (weapons components bearing Pu and HEU, respectively) and metals and oxides of Pu and HEU.

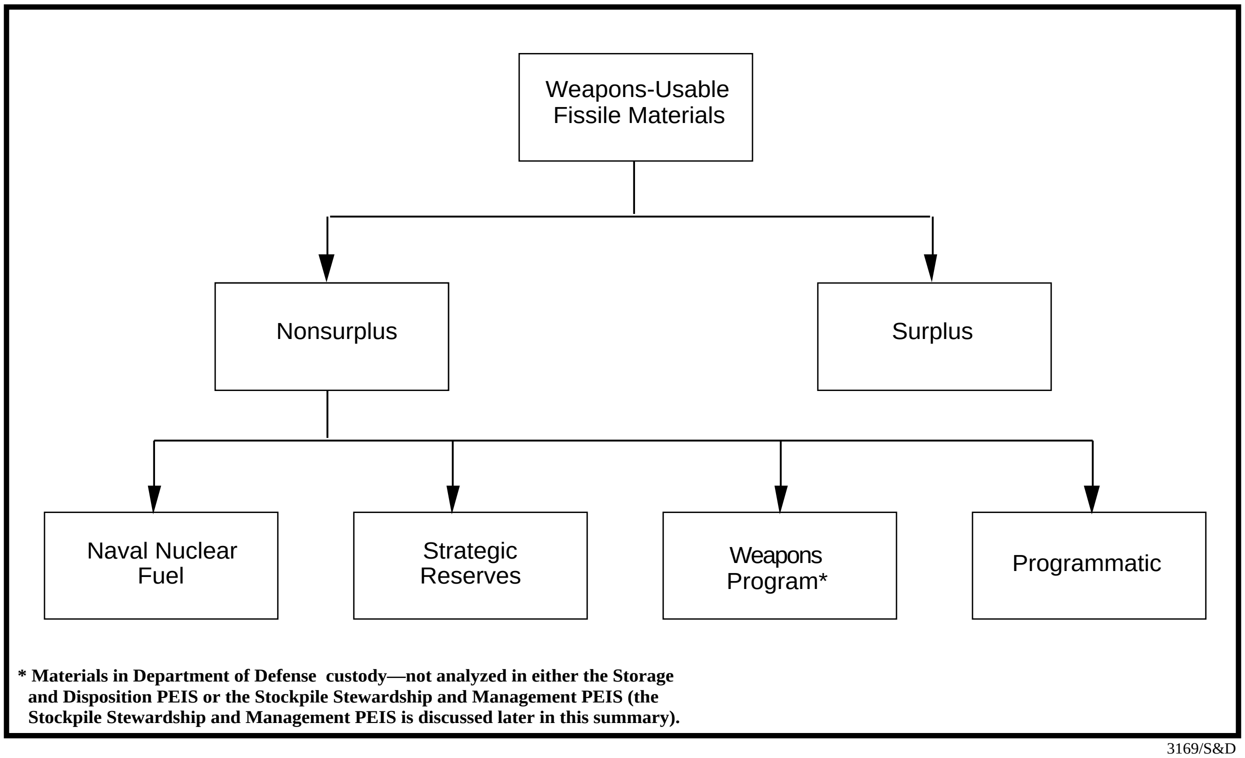

Figure S.1–1. Weapons-Usable Fissile Material Categories.

PURPOSE OF AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action is to implement the President's *Nonproliferation and Export Control Policy* in a safe, reliable, cost-effective, and timely manner. DOE is proposing a comprehensive program to accomplish this purpose by providing an exemplary long-term storage system for weapons-usable fissile materials, eliminating the stockpile of surplus weapons-usable Pu, and establishing the technical and program infrastructure that will provide for disposition of the surplus weapons-usable Pu in the United States.

The weapons-usable fissile materials declared surplus by the President (March 1995) are in various compositions and forms. A storage plan is needed to provide continued adequate control of these surplus materials and any that may be declared surplus in the future, from now through final disposition, as well as management and long-term storage of nonsurplus fissile materials that will not be subject to disposition. Approximately 89 t (98 tons) of Pu (reported in DOE's Openness Initiative on December 7, 1993) and 994 t (1,093 tons) of HEU (reported in DOE's Openness Initiative on June 29, 1994) were produced by the United States during the period its production facilities were in operation. Some of these materials have been used in weapons or for other programmatic purposes, some of the remainder have been declared surplus, and additional materials could be declared surplus in the future. Disposition of surplus Pu is needed to reduce reliance on institutional controls and to provide visible evidence of irreversible disarmament. Therefore, a comprehensive long-term storage and disposition action is needed to ensure that weapons-usable fissile materials are properly managed and to prevent the potential increase of environmental, safety, and health risks. DOE also recognizes the need to strengthen national and international arms control efforts by providing a storage and disposition model for the international community. This action will enhance U.S. credibility and flexibility in negotiations on bilateral or multilateral reductions of surplus weapons-usable fissile material inventories.

SCOPE OF THE PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

The Storage and Disposition PEIS analyzes the direct, indirect, and cumulative environmental effects of reasonable alternatives for the long-term storage of nonsurplus Pu and HEU, the storage of surplus Pu and HEU pending disposition, and the disposition of surplus Pu. A separate DOE document, *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement* (HEU EIS), addresses the disposition of surplus HEU. The HEU EIS (DOE/EIS-0240) was issued in June 1996, and the ROD published on August 5, 1996.

The Storage and Disposition PEIS includes analyses of storing 89 t (98 tons) of Pu and 994 t (1,093 tons) of HEU (reported in DOE's Openness Initiative referenced above). The PEIS also analyzes the disposition of a nominal 50 t (55.1 tons) of Pu, including the 38.2 t (42.1 tons) of Pu that has been declared surplus as well as Pu that may be declared surplus in the future (although the exact quantity of Pu that may be declared surplus is not known at this time). The locations of the surplus material in the DOE complex are shown in Figures S.1–2 and S.1–3.

The Storage and Disposition PEIS assumes that the weapons-usable fissile material is in a stabilized form; the PEIS begins, as a starting point, after stabilization has been completed. DOE is currently in the process of stabilizing and repackaging weapons-usable fissile materials and placing them in safe, secure storage awaiting decisions on long-term storage and disposition. For Pu, this is being accomplished in accordance with the corrective actions identified in DOE's *Plutonium Vulnerability Management Plan* (DOE/EM-0199). This plan was developed in response to an assessment in DOE's *Plutonium Working Group Report* (DOE/EH-0415) and recommendations by the Defense Nuclear Facilities Safety Board (DNFSB) in DNFSB Recommendation 94-1. In addition, Pu materials will also meet the *Criteria for Safe Storage of Plutonium Metals and Oxides* (DOE-STD-3013-94), a DOE standard for long-term storage (at least 50 years) of these materials. Similarly, the HEU materials requiring long-term storage will meet criteria for safe storage of HEU metals and oxides; these criteria are under development at this time. Appropriate environmental documentation will be prepared, as necessary, for stabilizing and repackaging the Pu and HEU materials to meet respective long-term storage criteria.

Following the discontinuance of nuclear weapons material production, large quantities of residues remained as a result of the chemical and thermal processes used to separate and purify Pu. Examples of residue forms include some impure oxides and metals, halide salts, combustibles, ash, sludges, and contaminated glass. To meet requirements of DOE's *Plutonium Vulnerability Management Plan*, as well as various compliance agreements with State and local regulatory agencies, some Pu residues must be stabilized. As a result of the stabilization process, portions of the residues will potentially be concentrated and stored. These concentrates may be in a form and concentration (greater than 50 percent Pu by weight) that is weapons-usable and are therefore included in the PEIS.[6]

The Storage and Disposition PEIS pertains to weapons-usable fissile materials that meet all of the standards and criteria previously described. Fissile materials present in spent nuclear fuel or irradiated targets from reactors

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[6] As a result of the stabilization process, there will also be non-weapons-usable Pu or HEU contaminated wastes or residues (less than 50 percent Pu by weight) that would not be within the scope of the PEIS. On November 19, 1996, DOE announced its intention to prepare an EIS on the *Management of Certain Plutonium Residues and Scrub Alloy Stored at the Rocky Flats Environmental Technology Site* (61 FR 58866). This EIS will evaluate the potential environmental impacts associated with reasonable management alternatives for certain Pu residues and all scrub alloy currently stored at RFETS.

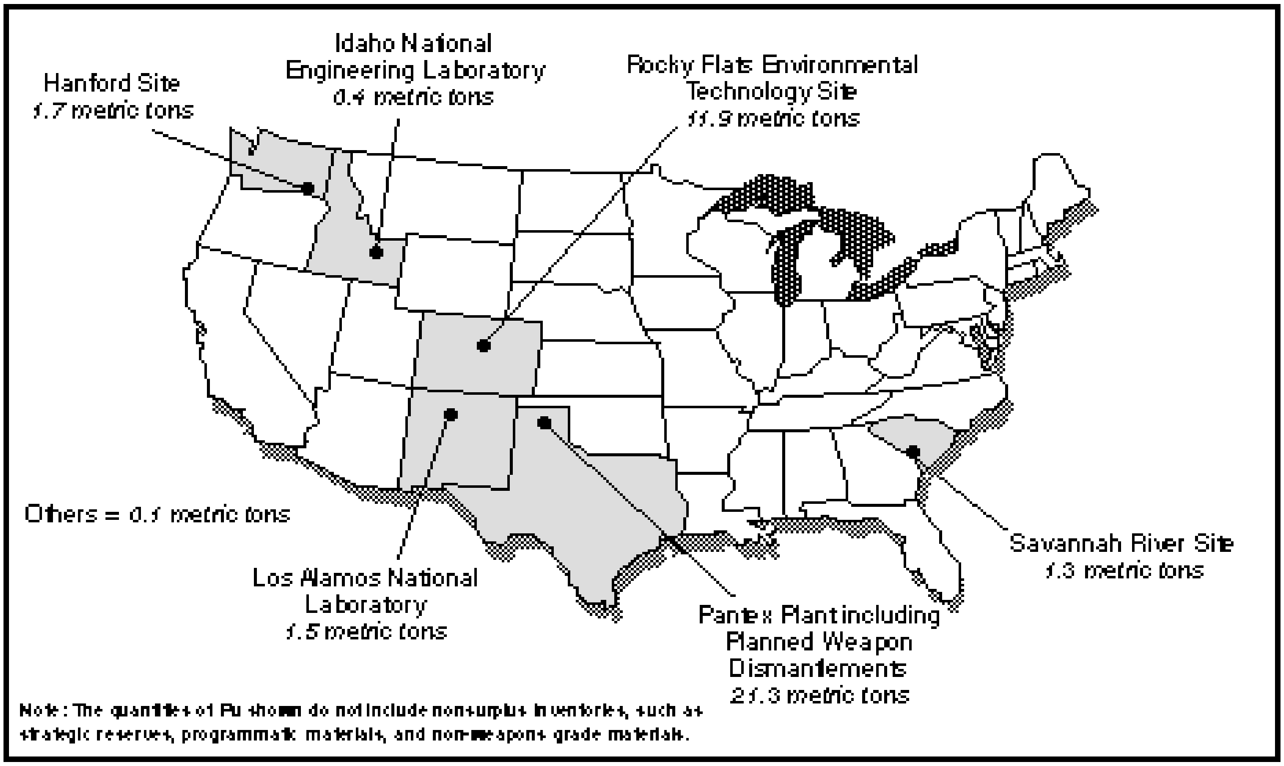

Figure S.1–2. Department of Energy Locations With Surplus Weapons-Grade Plutonium Inventories in September 1994.

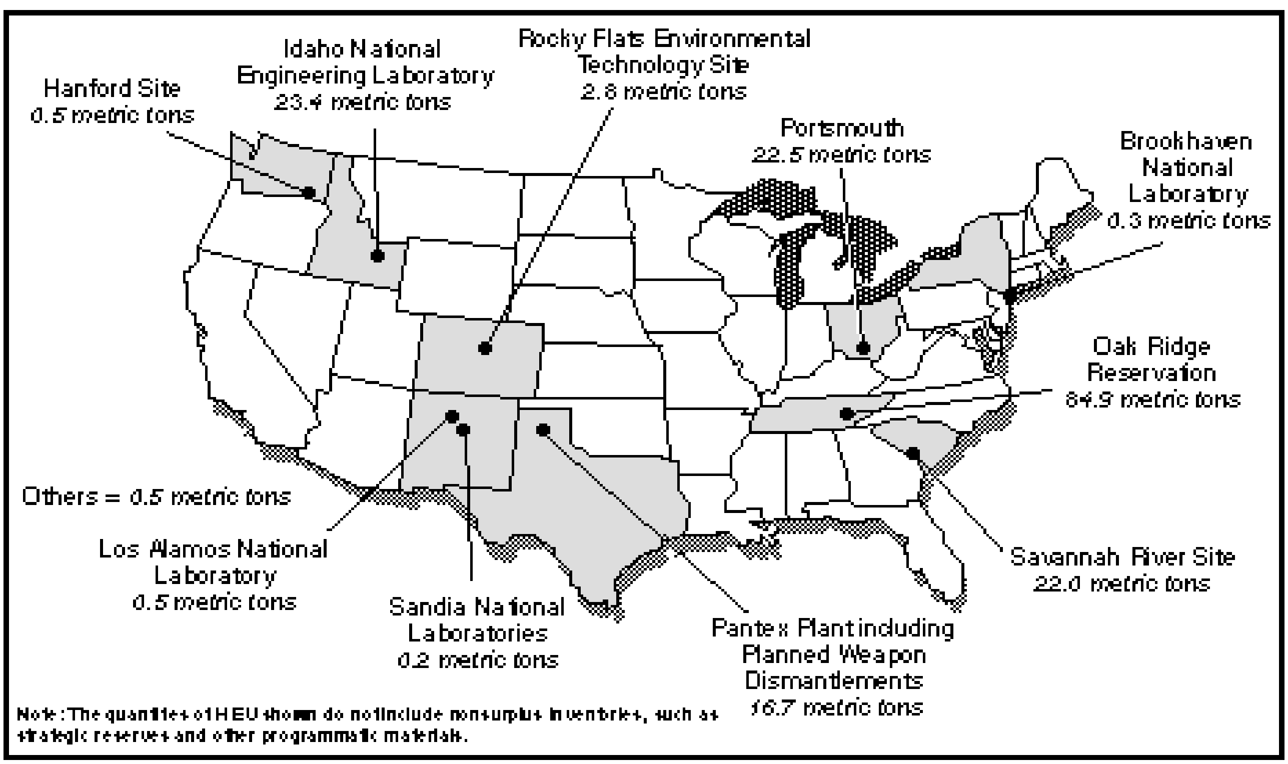

Figure S.1–3. Department of Energy Locations With Surplus Highly Enriched Uranium Inventories on February 6, 1996.

are not covered in the PEIS; they are not considered weapons-usable because separation of the relevant isotopes from these highly radioactive materials requires significant remote chemical processing. Reprocessing and extraction of Pu from spent fuel is not proposed, and is beyond the scope and the fundamental nonproliferation purpose of the program covered by the PEIS.

DECISIONS TO BE MADE

The Storage and Disposition Draft PEIS was circulated for public review and comment from March 8 through June 7, 1996. Eight public meetings in the vicinity of DOE sites under consideration for the Proposed Action, and in Washington, DC, were held during the comment period. Approximately 8,700 comments were received from other Federal government agencies, State and local governments, Native American tribes, special interest groups, and the public. These comments, along with DOE's responses, became a part of the Final PEIS. DOE also made available for public review, the results of the technical, cost and schedule analyses in July and October 1996, as well as the nonproliferation analysis in November 1996. Along with the PEIS, these analyses will support a formal ROD regarding Pu and HEU storage and surplus Pu disposition. [Text deleted.] These decisions are as follows:

For storage:

- The strategy for long-term storage of nonsurplus weapons-usable Pu and nonsurplus HEU
- The strategy for storage of surplus Pu and surplus HEU pending disposition
- The storage site(s) and (if appropriate) facilities

For disposition:

- The strategy and technologies for disposition of surplus weapons-usable Pu

The Department, with interagency coordination, will then issue the ROD. Following the ROD, subsequent tiered and project-specific NEPA documents will be prepared. The tiered NEPA reviews will analyze alternative locations for disposition activities.

Plutonium Immobilization

A process that converts Pu to a chemically stable form for disposition. The forms analyzed in the PEIS include glass (through vitrification), ceramic (through ceramic immobilization), and glass-bonded zeolite (through electrometallurgical treatment).

Mixed Oxide Fuel

A blend of uranium dioxide [UO_2] and plutonium dioxide [PuO_2] that produces a fuel suitable for use in a nuclear reactor to generate electric power.

Light Water Reactor

A nuclear reactor in which circulating water consisting of light water (hydrogen oxide [H_2O]) is used to cool the reactor core and reduce the energy of neutrons created in the core by fission reactions. All commercial reactors in the United States are LWRs.

Canadian Deuterium Uranium Reactor

A Canadian nuclear reactor in which the circulating water consists of heavy water (deuterium oxide). Deuterium is an isotope of hydrogen having twice the mass of hydrogen. All commercial reactors in Canada are heavy water reactors.

S.2 PREFERRED ALTERNATIVE

STORAGE

The Department's Preferred Alternative for storage is to reduce, over time, the number of locations where the various forms of Pu are stored, through a combination of storage alternatives in conjunction with a combination of disposition alternatives. DOE would begin implementing this Preferred Alternative by moving surplus Pu from RFETS as soon as possible, transporting the pits to Pantex as early as 1997, and the non-pit Pu materials to SRS beginning in 2002. Over time, DOE would store Pu in upgraded facilities at Pantex and in an expanded, planned new facility at SRS, and store nonsurplus HEU and surplus HEU pending disposition in upgraded and consolidated facilities at ORR. Storage facilities would also be modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy.* Accordingly, DOE's Preferred Alternative for storage would call for the following actions:

- **Phase out storage of all weapons-usable Pu at RFETS beginning in 1997; move pits to Pantex, and non-pit materials to SRS.** At Pantex, DOE would repackage pits from RFETS in Zone 12, then place them in existing storage facilities in Zone 4, pending completion of facility upgrades in Zone 12. At SRS, DOE would expand the planned new Actinide Packaging and Storage Facility (APSF), and move non-pit Pu materials from RFETS, after stabilization at RFETS, to the expanded APSF upon completion. The small number of pits currently at RFETS that are not in shippable form would be placed in a shippable condition in accordance with existing procedures prior to shipment to Pantex. Additionally, some pits and non-pit Pu materials from RFETS could be used at SRS, LANL, and LLNL for tests and demonstrations of aspects of disposition technologies (see Preferred Alternative for disposition as discussed later in this section). All non-pit weapons-usable Pu materials currently stored at RFETS are surplus.

- **Upgrade storage facilities at Zone 12 South (to be completed by 2004) at Pantex to store those pits currently stored at Pantex, and pits from RFETS, pending disposition. Storage facilities at Zone 4 would continue to be used for these pits prior to completion of the upgrade.** This action would place pits at a central location where most pits already reside and where expertise and infrastructure exist to accommodate pit storage.

- **In accordance with the Preferred Alternative in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (Stockpile Stewardship and Management PEIS), store Strategic Reserve pits at Pantex in the facilities discussed above. To the extent not reflected above, store Strategic Reserve materials in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS.**

- **Expand the APSF (Upgrade Alternative) at SRS to store those surplus, non-pit Pu materials currently at SRS and surplus non-pit Pu materials from RFETS, pending disposition** (see Preferred Alternative for disposition as discussed later in this section). The APSF would be built by 2001 pursuant to the *Final Environmental Impact Statement, Interim Management of Nuclear Materials* (IMNM EIS) (DOE/EIS-0220) and ROD, and the expansion to accommodate RFETS material would be completed by 2002. The RFETS surplus non-pit Pu materials would be moved to SRS after stabilization is performed at RFETS under corrective actions in response to recommendation 94-1 by the DNFSB, and after completion of the APSF expansion. This action would place non-pit Pu materials in a new storage facility, in a location with existing expertise and Pu handling capabilities and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). Strategic pits currently located at SRS would be stored in accordance with the Preferred Alternative in the Stockpile Stewardship and Management PEIS. There are no strategic non-pit materials currently located at SRS.

- **Continue current storage (No Action) of surplus Pu at Hanford and INEL, pending disposition** (or movement to lag storage[7] at the disposition facilities). This action would allow surplus Pu to remain at the sites with existing expertise and Pu handling capabilities, and where potential disposition activities could occur (see Preferred Alternative for disposition as discussed later in this section). There are no nonsurplus weapons-usable Pu materials currently stored at either site.

- **Continue current storage (No Action) of surplus Pu at LANL, pending disposition** (or movement to lag storage at the disposition facilities). This Pu would be stored in stabilized form with the nonsurplus Pu in the upgraded Nuclear Material Storage Facility pursuant to the No Action Alternative for the site.

- **Take No Action at the Nevada Test Site (NTS).** DOE would not add Pu to sites that do not currently have Pu in storage.

- **Upgrade storage facilities at the Y–12 Plant (Y–12) (to be completed by 2004, or earlier) at ORR to store nonsurplus HEU and surplus HEU pending disposition.** Existing storage facilities at Y–12 would be modified to meet natural phenomena requirements, as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). Storage facilities would be consolidated and the storage footprint would be reduced as surplus HEU is dispositioned and blended to low-enriched uranium, pursuant to the HEU EIS. Consistent with the Preferred Alternative in the Stockpile Stewardship and Management PEIS, HEU strategic reserves would be stored at the Y–12 Plant.

DISPOSITION

The Department's Preferred Alternative for the disposition of surplus Pu is to pursue a disposition strategy that allows for immobilization of surplus weapons Pu in glass or ceramic forms and burning of the surplus Pu as mixed oxide (MOX) fuel in existing reactors. The disposition of the surplus Pu using these technological approaches would depend on the results of future technology development and demonstrations, site-specific environmental analyses, and detailed cost proposals as well as nonproliferation considerations. The results of

[7] Lag storage is temporary storage at the applicable disposition facility.

these efforts and negotiations with Russia and other nations will ultimately determine the timing and extent to which either or both technologies are deployed.[8]

Under this Preferred Alternative, the U.S. policy not to encourage the civil use of Pu and, accordingly, not to itself engage in Pu reprocessing for either nuclear power or nuclear explosive purposes will not change. Although under the Preferred Alternative some Pu may ultimately be burned in existing reactors, every possible means will be pursued to ensure that Federal support for this unique disposition mission does not encourage other civil uses of Pu or Pu reprocessing. The United States, however, will maintain its commitments regarding the use of Pu in civil nuclear programs in Western Europe and Japan.

Proceeding with this strategy would provide increased flexibility to initiate Pu disposition promptly, and help assure disposition efforts could be accomplished in a timely manner. Establishing the means for expeditious Pu disposition would also help provide the basis for an international cooperative effort that can result in reciprocal, irreversible Pu disposition actions by Russia. DOE's preferred disposition strategy signals a strong U.S. commitment to reducing its stockpile of surplus Pu, thereby effectively meeting the purpose of and need for the Proposed Action.

To accomplish the Pu disposition mission, DOE would consider, to the extent practical, new as well as modified existing buildings and facilities for portions of the disposition activities. The PEIS analyzes new facilities for most disposition alternatives to obtain bounding environmental impacts. DOE would analyze and compare existing and new buildings and facilities for the technologies chosen as part of this strategy in subsequent, tiered NEPA review. In addition, all disposition facilities would be designed or modified, as needed, to accommodate international inspection requirements consistent with the President's *Nonproliferation and Export Control Policy.* Accordingly, DOE's Preferred Alternative for Pu disposition involves the following strategy and supporting actions:

- **Immobilize Pu materials using vitrification or ceramic immobilization.** The immobilization technology could be used for processing pure or impure forms of Pu. Vitrification or ceramic immobilization could include the can-in-canister variant, which could utilize the existing high-level wastes (HLW) and the Defense Waste Processing Facility (DWPF) at SRS, or new facilities at Hanford or SRS. DOE would continue the R&D leading to the demonstration of the can-in-canister variant at the DWPF using surplus Pu.

- **Convert Pu materials into MOX fuel for use in existing reactors.** Pure materials including pits, pure metal, and oxides could be converted without extensive processing into MOX fuel for use in existing commercial reactors. Other, already separated forms of surplus Pu would require additional cleanup (not reprocessing of spent nuclear fuel). The MOX fuel would be used in existing light water reactors (LWRs) with a once-through fuel cycle, with no reprocessing and subsequent reuse of the spent fuel. If partially completed LWRs were to be completed by other parties, they would be considered for this mission. The MOX fuel would be fabricated in a domestic, government-owned facility at a DOE site.

  The Department would retain using MOX fuel in Canadian Deuterium Uranium (CANDU) reactors in Canada in the event that a multilateral agreement to use CANDU reactors is negotiated among Russia, Canada, and the United States. DOE would engage in a test and demonstration for CANDU MOX fuel as appropriate and consistent with future cooperative efforts with Russia and Canada.

With regard to the above, for purposes of analysis of an approach involving a combination of both technologies, approximately 70 percent of the surplus Pu was identified to be in forms (metals and other pure forms) suitable

[8] Through these efforts, the President would be provided the basis and flexibility to initiate disposition efforts either multilaterally or bilaterally through negotiations or unilaterally as an example to Russia and other nations.

for MOX fuel. The actual percentage and timing for disposition of the surplus Pu using either or a combination of both of the technological approaches would depend on the results of international agreements, future technology development and demonstrations, site-specific environmental assessments, and detailed cost proposals to be completed within the next 2 years. The results of these efforts, as well as nonproliferation considerations and negotiations with Russia and other nations, will ultimately determine the timing and extent to which either or both technologies are deployed for disposition of surplus Pu. In the event both technologies are deployed, and because the time required for Pu disposition using reactors would be longer than that for immobilization, it is probable that some surplus Pu would be immobilized initially, prior to completion of reactor irradiation for other surplus Pu. Deployment of this strategy would involve the following supporting actions:

- **Constructing and operating a Pu vitrification or ceramic immobilization facility at either Hanford or SRS.** DOE would analyze alternative locations at these two sites for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. SRS has existing facilities and infrastructure to support an immobilization mission, and Hanford has existing plans for constructing and operating immobilization facilities for the wastes in Hanford tanks. DOE would not create new infrastructure for immobilizing Pu with HLW or cesium (Cs) at INEL, NTS, ORR, or Pantex.

- **Constructing and operating a Pu conversion facility[9] at either Hanford or SRS.** DOE would collocate the Pu conversion facility with the vitrification or ceramic immobilization facility discussed above. In subsequent, tiered NEPA reviews, DOE would analyze alternative locations at Hanford and SRS, for constructing new or potentially using modified existing buildings.

- **Constructing and operating a pit disassembly/conversion facility[10] at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review. DOE would demonstrate the Advanced Recovery and Integrated Extraction System (ARIES) concept at LANL for pit disassembly/conversion beginning in fiscal year 1997.

- **Constructing and operating a domestic, government-owned, MOX fuel fabrication facility at Hanford, INEL, Pantex, or SRS.** DOE would not add Pu to sites that do not currently have Pu in storage. Therefore, two sites analyzed in the PEIS, NTS and ORR, would not be considered further for Pu disposition activities. The MOX fuel fabrication facility would serve only the finite mission of fabricating MOX fuel using surplus Pu for the purpose of Pu disposition. DOE would analyze alternative locations at Hanford, INEL, Pantex, and SRS, for constructing new or potentially using modified existing buildings in subsequent tiered NEPA review.

Depending upon decisions in the ROD and pursuant to appropriate NEPA review(s), DOE would continue R&D and engage in further testing and demonstrations of Pu disposition technologies which may include: dissolution of small quantities of Pu in both glass and ceramic formulation; experiments with immobilization equipment and systems; fabrication of MOX fuel pellets for demonstrations of reactor irradiation at INEL; mechanical milling and mixing of Pu and feed forms; and testing of shipping and storage containers for certification, in addition to the testing and demonstrations previously described for the can-in-canister immobilization variant

[9] The Pu conversion facility would convert surplus non-pit Pu material (using a wet chemical process) into a metal or oxide form suitable for use at the next facility in the disposition process.

[10] The pit disassembly/conversion facility would dissemble, reshape, and convert surplus Pu pits (using a dry chemical process) into an unclassified metal or oxide form suitable for use at the next facility in the disposition process. In addition, some non-pit Pu material may also be processed in this facility.

and the ARIES. These tests and demonstrations would slightly reduce the quantity of RFETS pit and non-pit materials to be stored at Pantex and SRS, respectively.

The storage and disposition actions proposed for various DOE sites by the Preferred Alternative are summarized in Table S.2–1.

Table S.2–1. Storage and Disposition Actions Proposed by the Preferred Alternative

Action	Hanford	NTS	INEL	Pantex	ORR	SRS	RFETS	LANL
Storage								
No Action	X[a]	X[b]	X[a]					X[a]
Upgrade				X[c]	X[d]	X[e]		
Phaseout							X	
Disposition[f]								
Pit Disassembly/Conversion	X		X	X		X		
MOX Fuel Fabrication	X		X	X		X		
Pu Conversion	X					X		
Immobilization	X					X		

[a] Pending subsequent tiered NEPA decisions for disposition of surplus Pu.
[b] NTS does not currently store either Pu or HEU.
[c] For storage of those pits currently at Pantex and pits from RFETS.
[d] For storage of HEU only.
[e] For storage of only those Pu materials currently at SRS and non-pit Pu materials from RFETS.
[f] "X" denotes potential sites for locating the disposition facilities pending subsequent tiered NEPA decisions. Only one of each facility is needed for accomplishing the disposition mission.

S.3 DEVELOPMENT OF ALTERNATIVES

The Storage and Disposition PEIS analyzes a number of reasonable alternatives for storage and disposition in addition to the No Action Alternative. DOE used a screening process along with public input to identify a range of reasonable alternatives for the storage and disposition of weapons-usable fissile materials. The process was conducted by a screening committee that consisted of experts from DOE assisted by technical advisors from DOE's national laboratories and other support staff. The committee was responsible for identifying the reasonable alternatives to be evaluated. It compared alternatives against screening criteria, considered input from the public, and used technical reports and analyses from the national laboratories and industry to develop a final list of alternatives.

The first step in the screening process was to develop criteria against which to judge potential alternatives. The criteria were developed for the screening process based on the President's *Nonproliferation and Export Control Policy* of September 1993, the *Joint Statement Between the United States and Russia on Nonproliferation of Weapons of Mass Destruction and the Means of Their Delivery* of January 1994, and the analytical framework established by the National Academy of Sciences in its 1994 report, *Management and Disposition of Excess Weapons Plutonium*. The criteria include resistance to theft and diversion; resistance to retrieval and reuse; impact to environment, safety, and health (ES&H); public and institutional acceptance; timeliness and technological viability; cost-effectiveness; international cooperation; and additional benefits. The criteria were discussed at the public scoping workshops, and participants were invited to comment further using questionnaires. The questionnaires allowed participants to rank criteria based on relative importance, comment on the appropriateness of the criteria, and suggest new criteria. Details on how the screening process was developed and applied, and the results obtained from the process, were published in a separate report, the *Summary Report of the Screening Process* (DOE/MD-0002, March 1995). Figures S.3–1 and S.3–2 show the results of the screening process for the long-term storage and the disposition options, respectively, including the options that were selected as reasonable alternatives for analysis in the PEIS, the options that were disqualified and eliminated, and the reasons for disqualification and elimination (given in parentheses).[11]

STORAGE OPTIONS

NO ACTION	Baseline
UPGRADE EXISTING INTERIM STORAGE FACILITIES	Reasonable
CONSOLIDATE STORAGE AT DOE SITES	Reasonable
UTILIZE FACILITIES AT NON-DOE DOMESTIC SITES	Eliminated (Cost-Effectiveness, ES&H)
UTILIZE NON-DOMESTIC SITES	Disqualified (Higher Safeguard and Security Risks)

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Figure S.3–1. Results of the Screening Process—Long-Term Storage Options.

DEVELOPMENT OF LONG-TERM STORAGE ALTERNATIVES

For storage, DOE began with five potential alternatives (see Figure S.3–1), including the No Action Alternative. The screening process identified two action alternatives as reasonable: (1) upgrade storage facilities and (2) consolidate storage at DOE sites. The second alternative was later refined and converted into two alternatives: consolidate Pu storage at one site (while HEU storage remains at ORR), and collocation of Pu and HEU storage at one site. [Text deleted.] Subalternatives and options were also added (see discussions in next section). In addition, the Preferred Alternative for storage (discussed previously) was developed and reflects a combination of the Upgrade Alternative, sub-options, and the No Action Alternative.

To select candidate sites for long-term storage, DOE used a separate set of siting criteria consistent with those used in the evaluation of sites for reconfiguration of the Nuclear Weapons Complex in February 1991. The siting criteria included population; ES&H; socioeconomics; transportation; and site availability and flexibility. The process resulted in six candidate storage sites: Hanford, NTS, INEL, Pantex, ORR, and SRS.

Development of Long-Term Storage Subalternatives

With the exception of weapons program materials in use, the Storage and Disposition PEIS analyzes the environmental impacts of reasonable alternatives for long-term storage of all surplus and nonsurplus weapons-usable fissile material categories (see Figure S.1–1). In DOE's Stockpile Stewardship and Management PEIS, a portion of the nonsurplus weapons-usable fissile materials, namely the strategic reserve materials and the plutonium-242 (Pu-242) materials used for weapons R&D, is analyzed for long-term storage. The Preferred Alternative in the Stockpile Stewardship and Management PEIS is to move Pu-242 currently stored at SRS to LANL for long-term storage. The Storage and Disposition PEIS includes a subalternative analyzing the environmental effects of each long-term storage alternative without the strategic reserve materials and weapons R&D materials.[12] Preparation of these two documents is being closely coordinated to ensure that all necessary information is available to the decisionmaker. Preferred alternatives are being presented to the Secretary of Energy on both PEISs for the Secretary's decisions and the publication of the RODs.

Because of the cleanup agreement for RFETS, the proximity of RFETS to the Denver metropolitan area, and the fact that three out of the five most vulnerable facilities identified in DOE's *Plutonium Working Group Report on Environmental, Safety, and Health Vulnerabilities Associated With the Department's Plutonium Storage* (DOE/EH-0415, November 1994) are located at the site, RFETS is considered as a storage site only under the

[11] Following issuance of the screening report, two changes were made during subsequent meetings of the screening committee; that is, options I6 (glass material oxidation/dissolution system) and Rl (Euratom MOX fuel fabrication/reactor burning) were eliminated.

[12] The Storage and Disposition PEIS also analyzes the "umbrella" option, for each storage alternative, of storing strategic reserves and weapons R&D material together with other nonsurplus material.

STORAGE OPTIONS

S1	NO DISPOSITION ACTION (CONTINUED STORAGE)	Baseline
S2	RADIATION BARRIER ALLOY (STORAGE)	Eliminated (Open-Ended, ES&H)

DIRECT DISPOSAL OPTIONS

D1	DIRECT EMPLACEMENT IN HLW REPOSITORY	Disqualified (Retrievability, Timeliness)
D2	DEEP BOREHOLE (IMMOBILIZATION)	Reasonable
D3	DEEP BOREHOLE (DIRECT EMPLACEMENT)	Reasonable
D4	DISCARD TO WASTE ISOLATION PILOT PLANT	Disqualified (Capacity)
D5	HYDRAULIC FRACTURING	Disqualified (Technical Viability)
D6	DEEP WELL INJECTION	Disqualified (ES&H)
D7	INJECTION INTO CONTINENTAL MAGMA	Eliminated (Technical Viability, ES&H)
D8	MELTING IN CRYSTALLINE ROCK	Disqualified (Technical Viability)
D9	DISPOSAL UNDER ICE CAPS	Disqualified (Technical Viability, ES&H)
D10	SEABED (PLACEMENT ON OCEAN FLOOR)	Disqualified (ES&H)
D11	SUB-SEABED EMPLACEMENT	Eliminated (Technical Viability)
D12	OCEAN DILUTION	Disqualified (ES&H)
D13	DEEP SPACE LAUNCH	Eliminated (Retrievability, ES&H)

IMMOBILIZATION OPTIONS (WITH RADIONUCLIDES)

I1	UNDERGROUND NUCLEAR DETONATION	Disqualified (ES&H, Licensing/Regulatory)
I2	BOROSILICATE GLASS IMMOBILIZATION (RETROFITTED DWPF)	Eliminated[a]
I3	VITRIFICATION (BOROSICLICATE GLASS IMMOBILIZATION [NEW FACILITY])	Reasonable
I4	CERAMIC IMMOBILIZATION	Reasonable
I5	ELECTROMETALLURGICAL TREATMENT	Reasonable
I6	GLASS MATERIAL OXIDATION/DISSOLUTION SYSTEM	Eliminated (Technical Maturity)

REACTOR AND ACCELERATOR OPTIONS

R1	EURATOM MOX FABRICATION/REACTOR BURNING	Eliminated (Timeliness)
R2	EXISTING LWRs	Reasonable
R2A	PARTIALLY COMPLETED LWRs	Reasonable
R3	EVOLUTIONARY OR ADVANCED LWRs	Reasonable
R4	NAVAL PROPULSION REACTORS	Disqualified (Transparency)
R5	MODULAR HELIUM REACTORS	Eliminated (Technical Maturity)
R6	CANDU HEAVY WATER REACTORS	Reasonable
R7	ADVANCED LIQUID METAL REACTORS WITH PYROPROCESSING	Eliminated (Technical Maturity, ES&H)
R8	ACCELERATOR CONVERSION/MOLTEN SALT	Eliminated (Technical Maturity)
R9	ACCELERATOR CONVERSION/PARTICLE BED	Eliminated (Technical Maturity)
R10	EXISTING LWRs WITH REPROCESSING	Disqualified (Theft/Diversion, Policy)
R11	ADVANCED LWRs WITH REPROCESSING	Disqualified (Theft/Diversion, Policy)
R12	ACCELERATOR-DRIVEN MODULAR HELIUM REACTORS	Eliminated (Technical Maturity)
R13	ADVANCED LIQUID METAL REACTORS WITH RECYCLE	Disqualified (Technical Maturity, Policy)
R14	PARTICLE BED REACTORS	Eliminated (Technical Maturity)
R15	MOLTEN SALT REACTORS	Eliminated (Technical Maturity)

[a] In this option, the present DWPF at SRS would have a new, specially designed melter installed. Much of the supporting equipment would require major retrofitting for this application because DWPF was not designed for criticality control. Retrofitting the DWPF would create additional total personnel radiation exposure and would significantly interfere with its mission to stabilize and treat HLW, resulting in delays and cost escalation. Note that eliminating this "DWPF Upgrade" variant does not preclude other DWPF-related variants of the Vitrification and Ceramic Immobilization Alternatives (such as adding an adjunct melter adjacent to the DWPF or the can-in-canister approach in the DWPF) if these other variants do not introduce increased radiation or Pu criticality concerns into the DWPF. Can-in-canister at a retrofitted DWPF is discussed in Appendix O and would be examined along with other site-specific alternatives in subsequent NEPA review tiered from the PEIS.

Note: ES&H=Environmental Safety and Health.

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Figure S.3–2. Results of the Screening Process—Surplus Plutonium Disposition Options.

No Action Alternative in the Storage and Disposition PEIS. For other long-term storage alternatives, existing Pu stored at RFETS (approximately 12.9 t [14.2 tons], as stated in DOE's Openness Initiative of December 7, 1993) would be moved to one or more other Pu storage sites. Therefore, DOE developed a subalternative under the Upgrade at Multiple Sites Alternative to analyze the storage of all or some Pu from RFETS at each candidate site. The phaseout of Pu storage at RFETS is also analyzed.

Two other locations, LANL and LLNL, also store quantities of Pu material. As of September 1994, LLNL stored 0.3 t (0.3 tons), and LANL stored 2.7 t (3.0 tons) of Pu. Quantities at LLNL are weapons R&D and operational feedstock materials not surplus to government needs; consequently, none of the Pu stored at LLNL falls within the scope of the Storage and Disposition PEIS. Some Pu material at LANL does fall within scope of the Storage and Disposition PEIS. Approximately 1.5 t (1.7 tons) of Pu material at LANL have been declared surplus to national security needs. As a result, storage of the current Pu inventory at LANL is analyzed under the No Action Alternative. Because LANL is not a candidate storage site, environmental impacts associated with a partial phaseout at LANL and relocation of the surplus Pu material to one or more of the candidate storage sites, is analyzed.

DEVELOPMENT OF DISPOSITION ALTERNATIVES

For disposition, DOE began with 37 potential alternatives (see Figure S.3–2), including the No Disposition Action in which the surplus Pu would remain in long-term storage. Using the same general criteria as those for long-term storage, DOE identified 11 alternatives for surplus Pu disposition, including deep borehole (immobilization), deep borehole (direct emplacement), vitrification (borosilicate glass immobilization), ceramic immobilization, electrometallurgical treatment, glass material oxidation/dissolution, Euratom MOX fuel fabrication/reactor burning, existing LWRs, partially completed LWRs, evolutionary or advanced LWRs, and CANDU reactors. Upon further study of supply/demand conditions for Euratom MOX fuel and due to lack of maturity of the technologies for glass material oxidation/dissolution, DOE deleted the glass material oxidation/dissolution and the Euratom MOX fuel fabrication/reactor burning alternatives. However, MOX fuel fabrication (but not reactor burning) at European facilities remains a reasonable short-term option for the Existing LWR Alternative. Therefore, a total of nine reasonable disposition alternatives in addition to the No Disposition Action and the Preferred Alternative, were selected for analysis in the PEIS. These alternatives were grouped into three categories: Deep Borehole, Immobilization, and Reactor.

Facilities under each alternative within the Immobilization and Deep Borehole Categories could be designed such that they could disposition all the surplus Pu over their operating lives. Each disposition alternative under the Reactor Category would consist of reactors that could use all the MOX fuel produced from surplus Pu. However, existing surplus Pu comes in various forms, and some of these forms may not be suitable for conversion to MOX fuel without specialized chemical processing. The Preferred Alternative for disposition of surplus weapons-usable Pu, discussed previously, involves a combination of disposition alternatives.The Storage and Disposition PEIS identifies the reasonable long-term storage and disposition alternatives as follows:

Deep Borehole

A borehole extended several kilometers below the water table into ancient, geologically stable rock formations.

Storage:

- Storage Alternatives
  - Preferred Alternative (Combination)
  - Upgrade at Multiple Sites Alternative
  - Consolidation of Pu Alternative
  - Collocation of Pu and HEU Alternative
  - No Action Alternative

- Candidate Storage Sites
  - Hanford
  - NTS
  - INEL
  - Pantex
  - ORR
  - SRS

Environmental impacts of each storage alternative and the No Action Alternative are analyzed for each of the six candidate storage sites, to allow (1) the comparison of impacts by site for each alternative and (2) the comparison of impacts by alternative for each site. As a result, decisions can be made to select a single storage alternative for all sites or a combination of different alternatives for different sites.

Disposition:

- Preferred Alternative (Combination)

- Deep Borehole Category
  - Direct Disposition Alternative
  - Immobilized Disposition Alternative

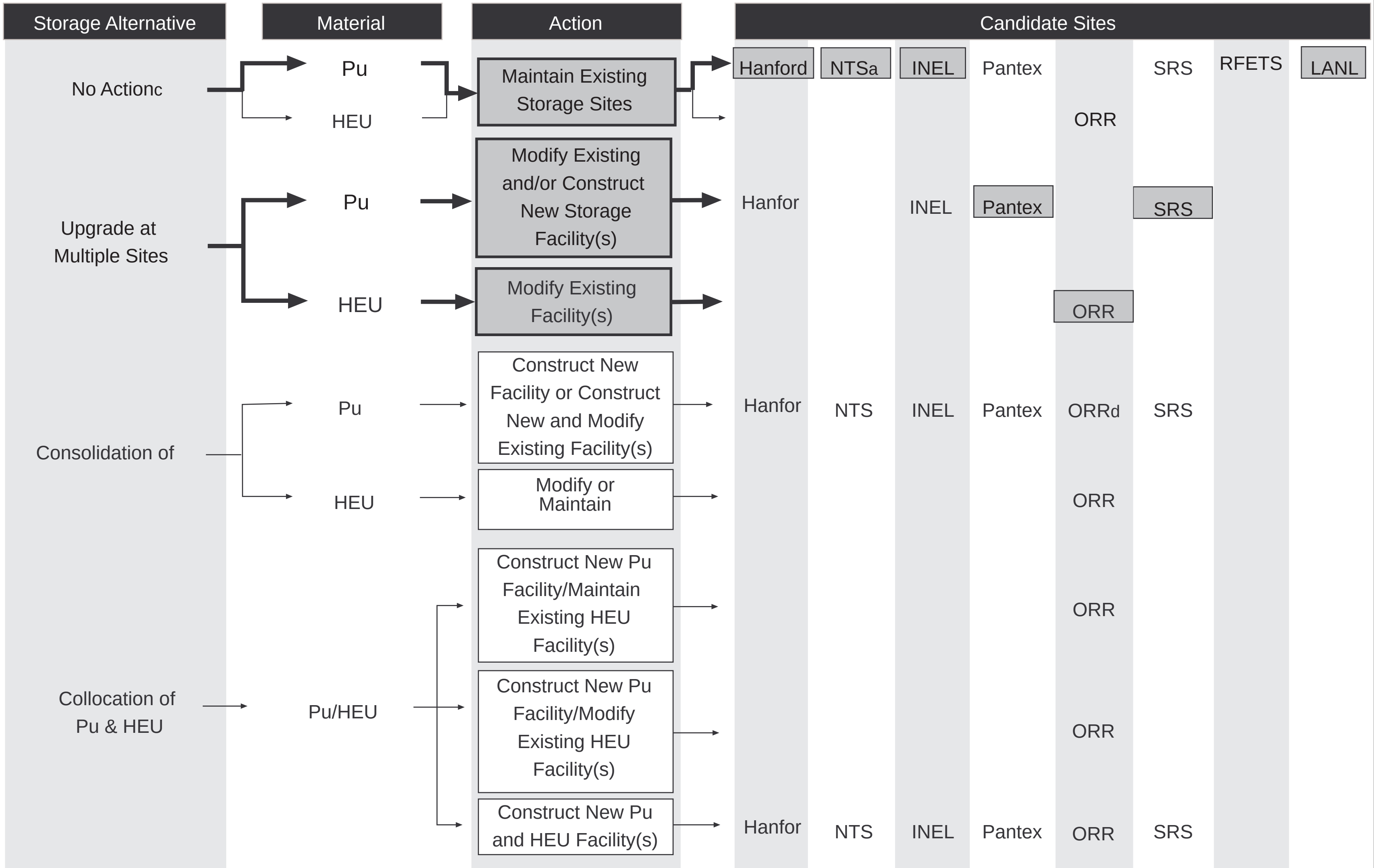
- Immobilization Category
  - Vitrification Alternative
  - Ceramic Immobilization Alternative
  - Electrometallurgical Treatment Alternative

- Reactor Category
  - Existing LWR Alternative
  - Partially Completed LWR Alternative
  - Evolutionary LWR Alternative
  - CANDU Reactor Alternative

- No Disposition Action

The Storage and Disposition PEIS analyzes the reasonable alternatives in addition to the No Action Alternative. For the No Action Alternative, all weapons-usable fissile materials would remain in storage at existing sites using proven nuclear material safeguards and security procedures. For the No Disposition Action Alternative, all weapons-usable fissile materials would remain in storage. The conceptual structures for the long-term storage and disposition alternatives, including the Preferred Alternative (in boldface text and shaded boxes), are presented in Figures S.3–3 and S.3–4, respectively. A more detailed description of these alternatives follows.

[Text deleted.]



a Although NTS does not currently store either Pu or HEU, the No Action Alternative is included here as a basis against which other storage and disposition alternatives are analyzed.
b As part of the Preferred Alternative, Pu storage at RFETS would be phased out with pits sent to Pantex and non-pit materials sent to SRS.
c Under the No Action Alternative, DOE would not undertake any new construction projects except those that are considered part of ongoing site operations to ensure continued safe, secure storage. However, any new facility construction deemed necessary to maintain safe, secure storage would be addressed in appropriate, individual site-specific EISs and site development plans.
d If Pu is consolidated at ORR, the presence of the HEU material already residing at the Y¥12 Plant would create a HEU collocation condition and is therefore portrayed as the Collocation Alternative.
Note: Bold text and shaded boxes indicate Preferred Alternative.

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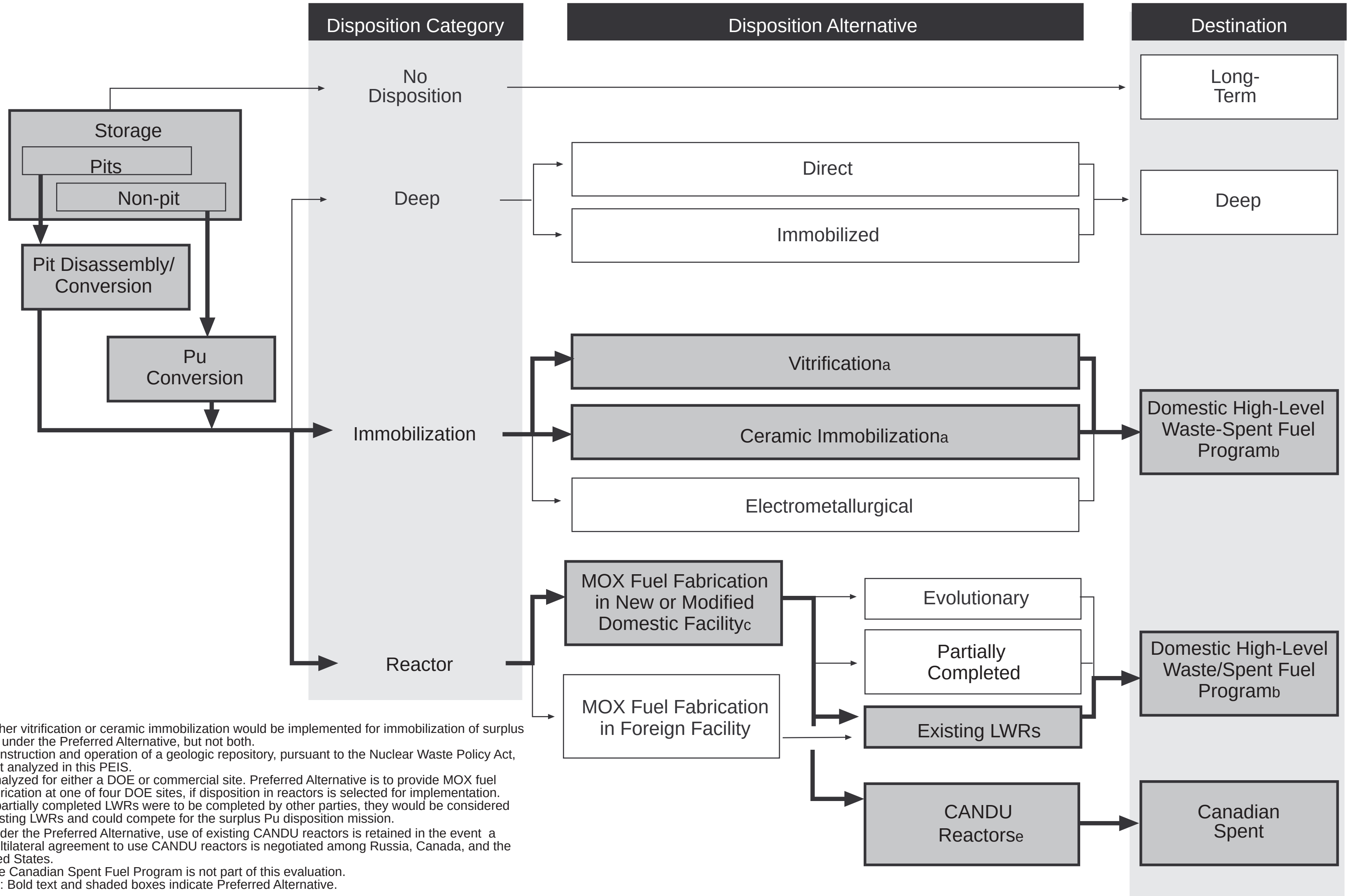
Figure S.3-3. Long-Term Storage Alternatives, Including the Preferred Alternative for Storage.



a Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.
b Construction and operation of a geologic repository, pursuant to the Nuclear Waste Policy Act, is not analyzed in this PEIS.
c Analyzed for either a DOE or commercial site. Preferred Alternative is to provide MOX fuel fabrication at one of four DOE sites, if disposition in reactors is selected for implementation.
d If partially completed LWRs were to be completed by other parties, they would be considered existing LWRs and could compete for the surplus Pu disposition mission.
e Under the Preferred Alternative, use of existing CANDU reactors is retained in the event a multilateral agreement to use CANDU reactors is negotiated among Russia, Canada, and the United States.
f The Canadian Spent Fuel Program is not part of this evaluation.
Note: Bold text and shaded boxes indicate Preferred Alternative.

Figure S.3-4. Surplus Plutonium Disposition Alternatives, Including the Preferred Alternative for Disposition.

S.4 DESCRIPTION OF ALTERNATIVES

S.4.1 LONG-TERM STORAGE ALTERNATIVES AND RELATED ACTIVITIES

No Action

[Text deleted.]

Under the No Action Alternative, all weapons-usable fissile materials would remain at existing storage sites. Maintenance at existing storage facilities would be done as required to ensure safe operation for the balance of the facility's useful life. Sites covered under the No Action Alternative include Hanford, INEL, Pantex, ORR, SRS, RFETS, and LANL. Although there are no weapons-usable fissile materials within the scope of the PEIS stored currently at NTS, it is also analyzed under No Action to provide an environmental basis against which impacts of the storage and disposition alternatives are analyzed. The Preferred Alternative for storage calls for No Action at Hanford, INEL, and LANL pending disposition.

Preferred Alternative

The Preferred Alternative for storage is described in Section S.2.

Upgrade at Multiple Sites

Under this alternative for storage, DOE would either modify certain existing facilities or build new facilities, depending on the site's requirements to meet standards for nuclear material storage facilities, and would utilize existing site infrastructure to the extent possible. These modified or new facilities would be designed to operate for up to 50 years. Pu materials currently stored at Hanford, INEL, Pantex, and SRS would remain at those four sites, and HEU would remain at ORR. This alternative does not apply to NTS because NTS does not currently store weapons-usable fissile materials that are within the scope of the PEIS.

A subalternative of relocating portions of the Pu inventory from RFETS and LANL (for a total of 14.4 t [15.9 tons] according to DOE's Openness Initiatives of December 7, 1993, and February 6, 1996, respectively) to one or more of the four existing Pu storage sites is analyzed. Storage without strategic reserve and weapons R&D materials is also included as a subalternative.

Within some of the five candidate storage sites under this alternative, there are one or more storage options. A summary of these options is presented in Table S.4.1–1.

Table S.4.1–1. Long-Term Storage Options for the Upgrade at Multiple Sites Alternative[a]

Candidate Site	Storage Option
Hanford	Modify Existing Fuels and Materials Examination Facility for Pu Storage, or
	Construct New 200 West Area Facility for Pu Storage
INEL	Modify Existing and Construct New Argonne National Laboratory-West Facilities for Continued Pu Storage
Pantex (Preferred Alternative)	Modify Existing Zone 12 South Facilities for Continued Pu Storage
ORR (Preferred Alternative)	Modify Existing Y–12 Plant Facilities for Continued HEU Storage
SRS (Preferred Alternative)	Modify New Actinide Packaging and Storage Facility for Continued Pu Storage

[a] Proposed storage facility locations were primarily based on optimal use of existing facilities, and are in accordance with current site development and utilization plans and proposals.

Consolidation of Plutonium

Under this alternative, Pu materials at existing sites would be removed, and the entire DOE inventory of Pu would be consolidated at one site, while the HEU inventory would remain at ORR. Again, the four sites with existing Pu storage are candidate sites for Pu consolidation. In addition, NTS and ORR are candidate sites for this alternative. Consolidation of Pu at ORR would result in a situation in which inventories of Pu and HEU are collocated at one site; this alternative is therefore analyzed as the Collocation Alternative at ORR.

A subalternative to account for the separate storage without strategic reserve and weapons R&D materials is also included. Storage options for the six candidate sites under this alternative are presented in Table S.4.1–2.

Table S.4.1–2. Long-Term Storage Options for the Consolidation of Plutonium Alternative

Candidate Site[a]	Storage Option
Hanford	Construct New Pu Storage Facility Adjacent to 200 East Area
NTS	Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel, or Construct New Pu Storage Facility in Area 6
INEL	Construct New Pu Storage Facility Adjacent to the Idaho Chemical Processing Plant
Pantex	Construct New and Modify Existing Zone 12 South Facilities, or Construct New Pu Storage Facility in Zone 12 South
SRS	Construct New Pu Storage Facility Adjacent to Z Area

[a] Consolidation of Pu at ORR results in a collocation condition with HEU. See ORR Collocation Alternative in Table S.4.1–3.

Collocation of Plutonium and Highly Enriched Uranium

Under the Collocation Alternative, the entire DOE inventory of Pu would be consolidated and collocated at the same site as the HEU inventory. The six candidate sites are Hanford, NTS, INEL, Pantex, ORR, and SRS.

A subalternative for the separate storage without strategic reserve and weapons R&D materials is also included. Storage options for the six candidate sites under this alternative are presented in Table S.4.1–3.

Table S.4.1–3. Long-Term Storage Options for the Collocation of Plutonium and Highly Enriched Uranium Alternative

Candidate Site	Storage Option
Hanford	Construct New Pu and HEU Storage Facilities Adjacent to 200 East Area
NTS	Modify Existing Tunnel Drifts and Construct New Material Handling Building at the P-Tunnel, or
	Construct New Pu and HEU Storage Facilities in Area 6
INEL	Construct New Pu and HEU Storage Facilities Adjacent to the Idaho Chemical Processing Plant
Pantex	Construct New Pu and HEU Storage Facilities in Zone 12 South
ORR	Construct New Pu Storage Facility Northwest of Oak Ridge National Laboratory and Maintain Existing (No Action) HEU Storage Facilities at Y–12 Plant, or Construct New Pu Storage Facility Northwest of Oak Ridge National Laboratory and Modify Existing HEU Storage Facilities at Y–12 Plant, or Construct New Pu and HEU Storage Facilities Northwest of Oak Ridge National Laboratory
SRS	Construct New Pu and HEU Storage Facilities Adjacent to Z Area

S.4.2 PLUTONIUM DISPOSITION ALTERNATIVES AND RELATED ACTIVITIES

[Text deleted.] The disposition technologies analyzed in the PEIS are those that would convert surplus Pu into a form that meets the Spent Fuel Standard. For the purpose of environmental impact analyses for the various disposition alternatives, both generic and specific sites are used to provide perspective on these alternatives. Under each alternative, there are various ways to implement the alternative. These "variants" (such as the can-in-canister[13]) are shown in Table S.4.2–1 to provide a range of available options for consideration.

The first step in Pu disposition is to remove the surplus Pu from storage, then process this material in a pit disassembly/conversion facility (for pits, a component of nuclear weapons) or in a Pu conversion facility (for non-pit materials). The processing would convert the Pu material into a form suitable for each of the disposition alternatives described in the following sections. The pit disassembly/conversion facility and the Pu conversion facility are assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the potential environmental impacts of constructing and operating these facilities.

No Disposition Action

A "No Pu Disposition" action means disposition would not occur, and surplus Pu-bearing weapon components (pits) and other forms, such as metal and oxide, would remain in storage in accordance with decisions on the long-term storage of weapons-usable fissile materials.

Preferred Alternative

The Preferred Alternative for disposition is described in Section S.2.

Deep Borehole Category

Under this category, surplus weapons-usable Pu would be disposed of in deep boreholes that are drilled at least 4 kilometers (km) (2.5 miles [mi]) into ancient, geologically stable rock formations beneath the water table. The deep borehole provides a geologic barrier against potential proliferation. A generic site is used for the construction and operation of a borehole complex where the surplus Pu would be prepared for emplacement in the borehole. This complex would consist of five major facilities: processing; drilling; emplacing/sealing; waste management; and support (security, maintenance, and utilities).

Direct Disposition

Under the Direct Disposition Alternative, surplus Pu would be removed from storage, processed as necessary, converted to a form suitable for emplacement, packaged, and placed in a deep borehole. The deep borehole would be sealed to isolate the Pu from the accessible environment. Long-term performance of the deep borehole would depend on the stability of the geologic system. A generic site is used for the borehole complex to analyze the environmental impact of this alternative.

Immobilized Disposition

Under the Immobilized Disposition Alternative, the surplus Pu would be removed from storage, processed, and converted to a suitable form for shipment to a ceramic immobilization facility. The output of this facility would be spherical ceramic pellets containing Pu, facilitating handling during transportation and emplacement. The ceramic pellets (about 2.54 centimeters [cm] [1 inch {in}] in diameter and containing 1 percent Pu by weight) would then be placed in drums and shipped to the borehole complex. At the deep borehole site, the ceramic

[13] In the can-in-canister variant, cans of Pu glass or Pu ceramic would be placed in a DWPF canister or a DWPF type canister. This canister would then be filled with borosilicate glass containing HLW. This variant is described in Appendix O of the Final PEIS.

Table S.4.2–1. Description of Variants Under Plutonium Disposition Alternatives

Alternatives Analyzed	Possible Variants
• Deep Borehole Direct Disposition	• Arrangement of Pu in different types of emplacement canisters.
• Deep Borehole Immobilized Disposition	• Emplacement of pellet-grout mix. • Pumped emplacement of pellet-grout mix. • Pu concentration loading, size and shape of ceramic pellets.
• New Vitrification Facilities	• Collocated pit disassembly/conversion, Pu conversion, and immobilization facilities. • Use of either Cs-137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • An adjunct melter adjacent to the DWPF at SRS, in which borosilicate glass frit with Pu (without highly radioactive radionuclides) is added to borosilicate glass containing HLW from the DWPF. • A can-in-canister approach at SRS in which cans of Pu glass (without highly radioactive radionuclides) are placed in DWPF canisters which are then filled with borosilicate glass containing HLW in the DWPF (See Appendix O of the Final PEIS). • A can-in-canister approach similar to above but using new facilities at sites other than SRS.
• New Ceramic Immobilization Facilities	• Collocated pit disassembly/Pu conversion, and immobilization facilities. • Use of either Cs-137 from capsules or HLW as a radiation barrier. • Wet or dry feed preparation technologies. • A can-in-canister approach at SRS in which the Pu is immobilized without highly radioactive radionuclides in a ceramic matrix and then placed in the DWPF canisters that are then filled with borosilicate glass containing HLW (See Appendix O of the Final PEIS). • A can-in-canister approach similar to above but using new facilities at sites other than SRS.
• Electrometallurgical Treatment (glass-bonded zeolite form)	• Immobilize Pu into metal ingot form. • Locate at DOE sites other than ANL-W at INEL.
• Existing LWR With New MOX Facilities	• Pressurized or Boiling Water Reactors. • Different numbers of reactors. • European MOX fuel fabrication. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, Pu conversion, and MOX facilities. • Reactors with different core management schemes (Pu loadings, refueling intervals).
• Partially Completed LWR With New MOX Facilities	• Same as for existing LWR (except that MOX fuel would not be fabricated in Europe).
• New Evolutionary LWR With New MOX Facilities	• Same as for partially completed LWR.
• Existing CANDU Reactor With New MOX Facilities	• Different numbers of reactors. • Modification/completion of existing facilities for MOX fabrication. • Collocated pit disassembly/conversion, Pu conversion, and MOX facilities. • Reactors with different core management schemes (Pu loadings, refueling intervals).

pellets would be mixed with ceramic pellets containing no Pu and fixed with grout during emplacement. The deep borehole would be sealed to isolate the Pu from the accessible environment. Long-term performance of the deep borehole would depend on the stability of the geologic system.

Although a generic site is used for the borehole complex in this alternative, the ceramic immobilization facility is assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of the facility.

Immobilization Category

Under this category of alternatives, surplus Pu would be immobilized to create a chemically stable form for disposal in a geologic repository pursuant to the *Nuclear Waste Policy Act* (NWPA).[14] The Pu material may be mixed with HLW or other radioactive isotopes and immobilized to create a radiation field that could serve as a proliferation deterrent, along with safeguards and security comparable to those of commercial spent nuclear fuel, thereby achieving the Spent Fuel Standard. All immobilized Pu would be encased in stainless steel canisters and would remain in onsite vault-type storage until a separate geologic repository pursuant to the NWPA is operational.

Vitrification

Under the Vitrification Alternative, surplus Pu would be removed from storage, processed, packaged, and transported to the vitrification facility. In this facility, the Pu would be mixed with glass frit and the highly radioactive isotope cesium-137 (Cs-137) or HLW to produce borosilicate glass logs (a slightly different process, using HLW, would be used for the can-in-canister variant discussed in Appendix O of the Final PEIS). The Cs-137 isotope could come from the cesium chloride (CsCl) capsules currently stored at Hanford or from existing HLW if the site selected for vitrification already manages HLW. Each glass log produced from the vitrification facility would contain about 84 kilograms (kg) (185 pounds [lb]) of Pu.

The vitrification facility is assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of this alternative.

Ceramic Immobilization

Under the Ceramic Immobilization Alternative, surplus Pu would be removed from storage, processed, packaged, and transported to a ceramic immobilization facility. In this facility, the Pu would be mixed with nonradioactive ceramic materials and Cs-137 or HLW to produce ceramic disks (a slightly different process, using HLW, would be used for the can-in-canister variant). Each disk would be approximately 30 cm (12 in) in diameter and 10 cm (4 in) thick, and would contain approximately 4 kg (9 lb) of Pu. The Cs-137 or HLW would be provided as previously described.

The ceramic immobilization facility is assumed to be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of this alternative.

Electrometallurgical Treatment

Under the Electrometallurgical Treatment Alternative, surplus Pu would be removed from storage, processed, packaged, and transported to new or modified facilities for electrometallurgical treatment. This process could immobilize surplus fissile materials into a glass-bonded zeolite (GBZ) form. With the GBZ material, the Pu is in the form of a stable, leach-resistant mineral that is incorporated in durable glass materials.[15]

[14] Also referred in the PEIS as a geologic, permanent, or HLW repository.

[Text deleted.]

Reactor Category

The reactor alternatives considered in the Storage and Disposition PEIS would utilize surplus Pu in MOX fuel for use in non-defense reactors. The irradiated MOX fuel would meet the Spent Fuel Standard to reduce the proliferation risks of the Pu material, and the reactors would also generate revenues through the sale of electricity. MOX fuel would be used in a once-through fuel cycle, with no reprocessing or subsequent reuse of spent fuel. The spent nuclear fuel generated by the reactors would then be sent to a geologic repository pursuant to the NWPA.

Because the United States does not have a MOX fuel fabrication facility or capability, a dedicated facility would likely have to be constructed or modified at a U.S. Government or existing commercial fuel fabricator's site. The surplus Pu from storage would be processed, converted to PuO_2, and transferred to the MOX fuel fabrication facility. In this facility, PuO_2 and UO_2 (from existing domestic sources) would be blended and fabricated into MOX pellets, loaded into fuel rods, and assembled into fuel bundles suitable for use in the reactor alternatives under consideration. The PEIS evaluates the potential environmental impacts of the MOX fuel fabrication facility at the six DOE sites and at a generic commercial site. MOX fuel fabrication at existing European facilities would be a viable option in the near-term to meet the initial fuel needs of the Existing LWR Alternative, pending availability of a domestic MOX fuel fabrication facility.[16]

Existing Light Water Reactor

Under the Existing LWR Alternative, the MOX fuel containing surplus Pu would be fabricated and transported to existing commercial LWRs in the United States, where the MOX fuel would be used instead of conventional UO_2 fuel. The LWRs employed for domestic electric power generation are pressurized water reactors (PWRs) and boiling water reactors (BWRs). Both types of reactors use the heat produced from nuclear fission reactions to generate steam that drives the turbines and generates electricity. The Storage and Disposition PEIS assumes a throughput of 3 to 5 t/year (yr) (3.3 to 5.5 tons/yr) for disposition of surplus Pu; three to five LWRs would be used. A sample of operating reactors (eight PWRs and four BWRs built after 1975) was compiled to obtain generic operating characteristics for environmental analysis of this alternative.

It is possible that an existing LWR can be configured to produce tritium, consume Pu as fuel, and generate revenue through the production of electricity. This configuration is called a multipurpose reactor. Environmental analysis of the multipurpose reactor is included in Chapter 4 of the *Final Programmatic Environmental Impact Statement for Tritium Supply and Recycling* (TSR PEIS) (DOE/EIS-0161, October 1995). In the TSR PEIS ROD (December 1995), the multipurpose reactor was preserved as an option for future consideration. Information on the Fast Flux Test Facility (FFTF) at Hanford and the costs and benefits of the multipurpose reactor is presented in Appendix N of the Final PEIS.

Partially Completed Light Water Reactor

Under the Partially Completed LWR Alternative, commercial LWRs on which construction has been halted would be completed. The completed reactors would use MOX fuel containing surplus Pu. The characteristics of

[15] The Department has recently issued a FONSI (61 FR 25647) and decision to proceed with the limited demonstration of the electrometallurgical treatment process at Argonne National Laboratory-West (ANL-W) at INEL for processing up to 125 spent fuel assemblies from the Experimental Breeder Reactor II (100 driver and 25 blanket assemblies). Although this alternative could be conducted at other DOE sites, ANL-W is described in the PEIS as the representative site for analysis. The National Research Council prepared a report called *An Evaluation of the Electrometallurgical Approach for Treatment of Excess Weapons Plutonium* (National Academy Press, Washington, DC, 1996). The results of this evaluation will be considered in DOE's decision-making process for Pu disposition.

[16] European MOX fuel fabrication would only be available in the near-term, and is not a part of the Preferred Alternative.

these LWRs would be essentially the same as those of the existing LWRs discussed in the Existing LWR Alternative. The Bellefonte Nuclear Plant located along the west bank of the Tennessee River in Alabama is used as a representative site for the environmental analysis of this alternative. Two reactor units (such as those at the Bellefonte Nuclear Plant) would be needed to implement this alternative.

Evolutionary Light Water Reactor

The evolutionary LWRs are improved versions of existing commercial LWRs. Two design approaches are considered in the Storage and Disposition PEIS. The first is a large PWR or BWR similar to the size of the existing PWR and BWR. The second is a small PWR approximately one-half the size of the large PWR. Two large or four small evolutionary LWRs would be needed to implement this alternative.

Under each design approach for this alternative, evolutionary LWRs would be built at a DOE site. Therefore, the six candidate sites for long-term storage were used to evaluate the environmental impact of this alternative.

Canadian Deuterium Uranium Reactor

Under the CANDU Reactor Alternative, the MOX fuel containing surplus Pu would be fabricated in a U.S. facility, then transported for use in a commercial heavy water reactor in Canada. The Ontario Hydro Nuclear Bruce-A Generating Station identified by the Canadians is used as a representative site for evaluation of this alternative. This station is located on Lake Huron about 300 km (186 mi) northeast of Detroit, Michigan. Environmental analysis of domestic activities up to the U.S./Canadian border is presented in the PEIS. The use of CANDU reactors would be subject to the policies, regulations, and approval of the Federal and Provincial Canadian Governments. Pursuant to Section 123 of the *Atomic Energy Act*, any export of MOX fuel from the United States to Canada must be made under an agreement for cooperation between the two countries. Spent fuel generated by a CANDU reactor would be accommodated within the Canadian spent fuel program.

S.5 APPROACH TO ENVIRONMENTAL IMPACT ANALYSIS

The environmental impact assessment addresses the full range of natural and human resource, and issue areas pertinent to the sites considered for the long-term storage and disposition alternatives. The resource/issue areas are land resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and paleontological resources, socioeconomics, public and occupational health and safety, waste management, intersite transportation, and environmental justice.

A region of influence (ROI) for each resource/issue area is identified and analyzed for each candidate site for long-term storage and each analysis site for disposition. Land resources address land use; land-use compatibility with existing land-use plans, controls, and policies; and the potential for visual resource impacts. Site infrastructure impacts are assessed by comparing the electrical power, fuel, and transportation network requirements against the existing capacities at each candidate site. Air quality and noise impacts focus on air pollutants and noise emissions and their compliance with the National Ambient Air Quality Standards, State air quality standards, and local government standards for noise.

For water resources, the water consumption requirements of each alternative were compared to the availability of surface and groundwater sources at each site, the potential effects of wastewater discharges on surface and groundwater quality are evaluated, and the site's location relative to floodplains assessed. Similarly, geology and soils are evaluated in terms of site suitability and soil erosion potential. Biological resources are evaluated in terms of the potential for impacts to terrestrial and aquatic resources, wetlands, and threatened and endangered species. Cultural and paleontological resources addresses the potential for disturbance to prehistoric, historic, Native American, and paleontological resources. The employment and income effects of new job creation and the attendant demands on community services and local transportation are analyzed for socioeconomics.

Both the public and onsite worker exposure to ionizing radiation and hazardous chemicals and the resultant increase in cancer fatality risk to public and occupational health and safety are assessed for normal operations and accident conditions. The analysis of radiation impacts includes consideration of National Emission Standards for Hazardous Air Pollutants (NESHAPs). The widely used algorithms for estimating the risk of latent cancers from radiation are based on high dose rates, and impacts are then extrapolated to low rates by presumed linear response models. These models are known to overestimate the risk for low dose rates. For the purposes of presentation in the PEIS, the impacts calculated from the linear model are treated as an upper bound case, consistent with the widely used methodologies for quantifying radiogenic health impacts. This does not imply that health effects are expected. Moreover, in cases where the upper bound estimates predict a number of latent cancer deaths that is greater that 1, this does not imply that the latent cancer death(s) are identifiable to any individual.

The additional wastes generated by each alternative are compared to existing and planned treatment, storage, and disposal capacities for potential impacts to waste management. Waste management assumptions are based on current site practices and are contingent upon decisions to be made following completion of the *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (DOE/EIS-0200).

The increased number of potential fatalities from truck accidents during the transportation of weapons-usable fissile materials among the various DOE sites and proposed facilities is evaluated for intersite transportation. Environmental justice addresses the potential for disproportionately high and adverse impacts to minority and low-income populations within 80 km (50 mi) of the sites.

The Storage and Disposition PEIS analyzes six candidate sites for the long-term storage of weapons-usable fissile materials. These sites are Hanford, NTS, INEL, Pantex, ORR, and SRS. These same sites were also used to evaluate the construction and operation of various facilities required for the disposition alternatives. These facilities include the pit disassembly/conversion and the Pu conversion facilities common to all disposition alternatives, the MOX fuel fabrication facility common to all reactor alternatives, the ceramic immobilization facility for the deep borehole alternative, the glass vitrification and ceramic immobilization facilities, and the Evolutionary LWR Alternative.

Other sites analyzed for Pu disposition are the ANL-W site at INEL for the Electrometallurgical Treatment Alternative and the Bellefonte Nuclear Plant for the Partially Completed LWR Alternative. These sites are used for analysis only and do not represent a DOE proposal or preference. Alternative sites may be analyzed in subsequent NEPA documents. A generic borehole site is evaluated for the alternatives in the Deep Borehole Category.[17] The Existing LWR Alternative analysis uses generic operating characteristics developed from 12 operating LWRs within the United States, and impacts are assessed using a generic site that was developed based on a composite of existing sites.

S.6 PREFERRED ALTERNATIVE SUMMARY OF IMPACTS

This section summarizes the maximum site impacts that would result at Hanford, INEL, Pantex, and SRS from combining the Preferred Alternative for storage with the Preferred Alternative for disposition at each of these sites. The Preferred Alternative identifies these sites as possible locations for all or some Pu disposition activities. The siting, construction, and operation of disposition facilities and variants would be covered in future tiered NEPA analyses. To the extent practical, DOE would use modified existing buildings and facilities for portions of the disposition activities. The use of existing buildings would reduce the environmental impacts and resource usages identified in this section.

[17] If either Borehole Alternative were selected, DOE would prepare a siting study and tiered NEPA documentation to identify and assess impacts of potential alternative borehole sites. DOE would analyze and compare existing and new buildings and facilities for the technologies chosen as part of the Preferred Alternative in subsequent, tiered NEPA review.

The preferred strategy for disposition is a combination of alternatives which includes operating existing reactors with MOX fuel and immobilization of some of the surplus Pu. The impacts from the operation of most of the existing domestic LWRs would not affect DOE sites. For purposes of analysis, approximately 70 percent of the surplus Pu, which is high purity material, could be readily converted into MOX fuel for use in nuclear reactors. The Preferred Alternative is to use existing reactors. DOE would retain using CANDU reactors in the event of a multilateral agreement among Russia, Canada, and the United States. For purposes of analysis, approximately 30 percent (low purity Pu) would be immobilized in glass or ceramic forms although much of it could be purified with chemical processing and used as MOX fuel in reactors. Disposition by use in reactors would require the construction of a MOX fuel fabrication facility and a pit disassembly/conversion facility at DOE sites. Disposition by immobilization would require the construction of a Pu conversion facility and an immobilization facility (either ceramic immobilization or vitrification) at a DOE site. Four DOE sites (Hanford, INEL, Pantex, and SRS) would be potential locations for MOX fuel fabrication and pit disassembly/conversion facilities, and two sites (Hanford and SRS) for the Pu conversion and immobilization facilities.

The following sections describe the total life cycle impacts that would result from the implementation of the Preferred Alternative at the DOE sites identified for potential placement of the disposition facilities. The analysis conservatively assumed a maximum impact scenario where two or four new disposition facilities could be built at the same DOE site. For immobilization, the analysis conservatively uses impacts from the ceramic immobilization facility since they are generally larger than the impacts from the vitrification facility. If existing facilities (such as the DWPF at SRS and the FMEF at Hanford) were used for some of the disposition activities, the impacts would be reduced.

Land Resources

Collocating disposition facilities at Hanford, INEL, Pantex, or SRS would likely minimize land-use impacts due to the sharing of land resources. In addition, optimal use of existing buildings and facilities would occur where possible. All four sites would have adequate land area to accommodate the facilities. Most disposition facilities would be separated from the site boundary by a 1.6-km (1-mi) buffer zone. For all four DOE sites, construction and operation would not affect other onsite or offsite land uses. No prime farmlands exist onsite. Construction and operation would be compatible with site, State, and local land-use plans, policies, and controls. This section describes the impacts to land resources from constructing and operating the Preferred Alternative storage and disposition facilities for each site.

Hanford Site. Plutonium materials would continue to be stored at the Plutonium Finishing Plant (PFP) in the 200 West Area, pending decisions on their disposition. The potential pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. The total area disturbed during construction would be approximately 191 hectares (ha) (472 acres); operation would require approximately 133 ha (329 acres). Construction and operation of the facilities would conform to existing and future land use plans as described in the current *Hanford Site Development Plan* and ongoing discussions in the comprehensive land-use planning process.

Construction and operation of these facilities would also be consistent with the industrialized landscape character of the 200 Area and with the current Visual Resource Management (VRM) Class 5 designation. The ceramic immobilization facility or MOX facility could have stack plumes that could be visible from public viewpoints with high sensitivity levels, including State Highways 24 and 240 and the city of Richland; however, the proposal would be compatible with the existing industrial character of the Hanford area.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at the Idaho Chemical Processing Plant (ICPP) and at ANL-W in the Zero Power Physics Reactor (ZPPR) and Fuel Manufacturing Facility (FMF) vaults, pending decisions on their disposition. The potential pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The total area disturbed during construction would be approximately 135 ha (334 acres);

operation would require approximately 93 ha (230 acres). Construction and operation would be consistent with the *Idaho National Engineering Laboratory Site Development Plan*, which designates the ICPP as situated within the Central Core Area/Prime Development Zone at INEL.

Construction and operation of these facilities would also be consistent with the industrialized landscape character of the ICPP and with the current VRM Class 5 designation. The MOX facility may have stack plumes that could be visible from off-site public viewpoints; however, the proposal would be compatible with the existing industrial character of the area.

Pantex Plant. Buildings 12-66 and 12-82 in Zone 12 South would be modified to accommodate the long-term storage of Pantex pits and RFETS pits under the Preferred Alternative. Construction and operation would require less than 1 ha (2.5 acres) and conform with the current *Pantex Site Development Plan*, which includes as part of its master plan the Fissile Material Storage Facility in Zone 12. Zone 12 is also the potential location for the pit disassembly/conversion facility. Construction and operation would require less than 14 ha (35 acres) and conform with the Pantex Site Development Plan, which designates Zone 12 for weapon assembly/disassembly. The total area disturbed during construction would be approximately 135 ha (334 acres); operation would require approximately 93 ha (230 acres). When completed, the potential MOX fuel fabrication facility would be located on previously undeveloped land in Zone 11, which is currently designated for applied technology. However, Pantex could revise the site development plan to accommodate the potential MOX facility.

The existing Zone 12 VRM Class 5 designation would not change due to the Preferred Alternative. The MOX facility in Zone 11 may have stack plumes that could be visible from off-site viewpoints; however, the proposal would be compatible with the existing site industrial character of the area.

Savannah River Site. The APSF in F-Area would be modified to accommodate the long-term storage of SRS non-pit Pu material and RFETS non-pit Pu material for the Preferred Alternative. Approximately 191 ha (472 acres) of vacant land in the F-Area would be disturbed during construction of the pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and ceramic immobilization facilities. The completed facilities would occupy approximately 133 ha (329 acres). Construction and operation would conform with existing and future land use as designated by the current *Savannah River Site Development Plan.* According to the Plan, current F-Area land use is designated industrial operations, while the future land-use category is primary industrial mission. Although the proposal would convert undeveloped land, forested land, and a very small portion of National Environmental Research Park lands, the action would conform with site land-use plans.

Construction and operation of the upgrade storage, pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities would be consistent with the industrial landscape character and current VRM Class 5 designation of the F-Area. Construction and operation of the MOX facility would change the current VRM Class 4 designation of the proposed site north of the P-Reactor Area to Class 5. The ceramic immobilization and MOX facilities may have stack plumes; however, because of hilly terrain, visual effects to public access roads with high sensitivity levels would not be apparent.

Site Infrastructure

The resource requirements for the construction of the proposed facilities are not expected to exceed site capabilities for any of the sites evaluated. At Hanford, the planned facilities use natural gas as the primary utility fuel, and the total requirement for natural gas (13,609,000 cubic meters [m^3]/yr [17,800,000 cubic yds {yd^3}/yr]) would be larger than currently available. Since INEL and SRS use fuel oil as the primary utility fuel, use of natural gas in lieu of fuel oil would require additional infrastructure. Final designs for facilities under the Preferred Alternative at INEL and SRS would be adapted to use fuel oil. At SRS the oil requirement would exceed the site availability by 277,750 liters (l)/yr (73,370 gallons [gal]/yr). Additional oil and natural gas requirements could be met by increasing procurement at all sites. Locating the Preferred Alternative disposition actions at any of the analyzed sites would require the construction of additional onsite roads and rail spurs.

Air Quality and Noise

Construction and operation of the proposed facilities under the Preferred Alternative would generate criteria and toxic/hazardous air pollutants. To evaluate air quality impacts at Hanford, INEL, Pantex, and SRS, potential concentrations from the facilities have been compared to Federal and State guidelines.

Concentrations of particulate matter less than or equal to 10 microns in diameter (PM_{10}) and total suspended particulates (TSP) are expected to increase during construction of the facilities. Simultaneous construction of the facilities could result in elevated levels of these pollutants. However, appropriate control measures would be implemented to maintain fugitive emissions within applicable Federal and State ambient air quality standards during construction.

The Prevention of Significant Deterioration (PSD) regulations, which are designed to protect ambient air quality in attainment areas, apply to new sources and major modifications to existing sources. Based on estimated emission rates, PSD permits may be required at all of the sites under consideration for the Preferred Alternative facilities. PSD permits may require inclusion of “offsets” (reductions of existing emissions) for any additional or new emission source.

Noise sources associated with the Preferred Alternative facilities may include construction equipment, increased traffic, ventilation equipment, cooling systems, and emergency diesel generators. The contribution to offsite noise levels would continue to be small at all of the sites because the facilities associated with the Preferred Alternative would be a sufficient distance away from the site boundary and sensitive receptors. Due to the large size of the sites, noise emissions from construction and operation activities would not be expected to cause annoyance to the public.

Water Resources

The construction and operation of the proposed facilities under the Preferred Alternative at Hanford, INEL, Pantex, and SRS would affect water resources. All facilities would be constructed outside of the 100-year, 500-year, and probable maximum flood; although the 500-year floodplain is not completely mapped at SRS, the facilities would likely be located outside the 500-year floodplain. Flooding from dam failures and flooding from a landslide resulting in river blockage would only be potentially possible at Hanford or INEL, but are not expected to occur. Wastewater discharges at all sites are expected to continue to meet National Pollutant Discharge Elimination System (NPDES) limits and reporting requirements at all sites.

Hanford Site. Surface water obtained from the Columbia River would be used as the water source for operation of the proposed facilities. The total water requirement for the Preferred Alternative at Hanford would be less than 1 percent of the Columbia River’s average annual flow (3,360 m^3/s [118,700 ft^3/s]). The withdrawals are negligible in comparison with the average flow of the river and would not noticeably affect the local or regional water supply.

The wastewater discharge would account for a 98-percent increase over the No Action Alternative projected discharge. The wastewater would be treated in newly constructed sanitary, utility, and process wastewater treatment systems prior to disposal.

Idaho National Engineering Laboratory. Water requirements for the operation of the Preferred Alternative at INEL would be obtained from groundwater sources. The water requirements for the site over the projected No

Action Alternative water usage would be less than a 0.05-percent increase for construction (approximately 0.24 percent of the groundwater allotment) and a 2-percent increase for operations (approximately 9.6 percent of the groundwater allotment).

The wastewater discharged during operations would represent a 24-percent increase over the projected No Action Alternative discharge. Existing INEL treatment facilities could accommodate all the new Preferred Alternative processes and wastewater streams. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed to accommodate the increase.

***Pantex Plant*.** Water requirements for the operation of technologies identified in the Preferred Alternative for Pantex would be obtained from groundwater resources or, if feasible, from the City of Amarillo Hollywood Road Wastewater Treatment Plant. Should only groundwater be used, the total annual site groundwater withdrawal, including that required for the Preferred Alternative in the year 2005 (the No Action base year), would be 428 million l/yr (113 million gal/yr). This represents a 72-percent increase in the projected No Action Alternative water usage. Because the projected No Action Alternative water usage reflects reductions in water use due to planned downsizing over the next few years, this quantity (No Action plus the Preferred Alternative) is considerably less than what is currently being withdrawn at Pantex (836 million l/yr [221 million gal/yr]). Pantex's groundwater usage would still contribute to the overall declining water levels of the Ogallala Aquifer.

Total estimated wastewater discharge for the Preferred Alternative (283 million l/yr [74.8 million gal/yr]) at Pantex would result in a 100-percent increase in the projected No Action Alternative discharge. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed to accommodate the increase.

Savannah River Site. Water requirements during operation of the Preferred Alternative would be obtained from existing or new well fields at SRS. The Preferred Alternative water requirements for the site would be a 3.7-percent increase over projected No Action Alternative groundwater usage. Suitable groundwater from the deep aquifers at the site is abundant, and aquifer depletion is not a problem.

The Preferred Alternative wastewater discharge to the river would be less than 5 percent of the minimum flow of Fourmile Branch (0.16 m^3/s [5.7 ft^3/s]), and less than 0.003 percent of the Savannah River average flow (283 m^3/s [9,990 ft^3/s]). SRS treatment facilities could accommodate all the new processes and wastewater streams if a new facility is built for tritium supply and recycling operations as planned. If necessary, new sanitary, utility, and process wastewater treatment systems would be constructed to accommodate the increase.

Geology and Soils

The construction of the potential facilities under the Preferred Alternative would involve some ground disturbing activities at Hanford, INEL, Pantex, and SRS (see discussion under Land Resources). Ground disturbance increases the potential for soil erosion. The key factors affecting the erosion potential of a site are the amount of disturbed land and the amount of annual precipitation. The potential for soil erosion at Hanford, INEL, and Pantex is slight because of low precipitation. Since SRS receives more precipitation, the potential for erosion is considered moderate. The amount of soil loss would depend on factors such as the frequency and severity of precipitation events; wind velocities; and the area, location, and duration of soil disturbance.

During operation, improvements to buildings, roads, and landscaping would considerably reduce the erosion potential. Erosion from stormwater runoff and wind could occasionally occur during operation of the facilities. Beyond increased erosion potential, no direct or indirect effects on geologic resources are anticipated.

Biological Resources

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area. Construction of the pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East and would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests and young animals living within the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Wetlands or aquatic resources would not be affected since no wetlands or surface water bodies exist near the assumed facilities locations. During both construction and operation, water would be withdrawn from the Columbia River through an existing intake structure, and wastewater would be discharged to evaporation/infiltration ponds. Wetlands or aquatic resources bordering the river would not be affected because the volume of water required represents a small percentage of the flow of the river.

It is unlikely that federally listed threatened and endangered species would be affected by construction and operation of the four disposition facilities, but sagebrush habitat would be disturbed. The sagebrush community is an important nesting/breeding and foraging habitat for several State-listed and candidate species, such as the ferruginous hawk, loggerhead shrike, western burrowing owl, pygmy rabbit, western sage grouse, and sage thrasher. Pre-activity surveys would be conducted as appropriate before construction to determine the occurrence of plant species or animal species and habitat in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the *Endangered Species Act* (ESA) and other statutes as appropriate.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at the ICPP and at ANL-W in the ZPPR and FMF vaults. Construction of the pit disassembly/conversion and MOX facilities on undeveloped land within or near the ICPP security area would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would be expected not to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests and young animals living with the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Wetlands and aquatic resources associated with the nearest surface water body, the Big Lost River, are located 1.6 km (1 mi) from the facility location. Due to the lack of wetlands or aquatic resources at the assumed facility locations, these resources would not be affected by construction or operation of the two facilities.

It is unlikely that federally threatened or endangered species would be affected by construction of the two disposition facilities, but several State-listed species may be affected. Burrows and foraging habitat for the pygmy rabbit would be lost. Bat species such as the Townsend's western big-eared bat may roost in caves and forage through the assumed site. One State-listed sensitive plant species could potentially be affected by construction of the facility. The plant species, tree-like oxytheca, has been collected at eight sites on INEL and at only two other sites in Idaho. If present, individual plants of this species could be destroyed during land clearing activities. Preactivity surveys would be conducted as appropriate before construction to determine the occurrence of these species and habitat in the area to be disturbed. DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate. No impacts to threatened and endangered species are expected due to facility operation.

Pantex Plant. Upgrading the existing storage Pu storage facility at Pantex would cause minimal disturbance to biological resources because all activities, including some new construction, would take place within the developed area. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the developed area have already adapted to its presence. Impacts to wetlands and aquatic resources would not occur since these resources do not exist in the upgrade area. Since the upgrade would take place within a developed area, impacts to threatened and endangered species would not be expected.

Both the pit disassembly/conversion facility location in Zone 12 and the MOX fuel fabrication facility location in Zone 11 lack natural vegetation. Disturbance of wildlife would be limited due to the existing disturbed nature of the assumed locations; however, small mammals and some birds and reptiles could be displaced by construction. Since the area around both locations does not contain any wetlands or aquatic resources, these resources would not be affected by construction of the facility. During operation, wastewater would be discharged to site playas through NPDES-regulated outfalls. The additional wastewater could lead to minor increases in open water near the outfalls, as well as changes in plant species composition. It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of the facilities. Although the assumed sites have been disturbed, it is possible that the State-listed Texas horned lizard could be present. Before construction, preactivity surveys would be conducted, as appropriate to determine the presence of any special status species and habitat on the proposed site; DOE would also consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate.

Savannah River Site. No additional impacts on biological resources are expected from modifying the APSF in F-Area to accommodate the storage of RFETS non-pit Pu material in addition to SRS non-pit Pu material because the modification would only use previously disturbed land.

For the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities, impacts to terrestrial resources would be minimal because the F-Area is one of the highly developed industrial areas of the SRS. Noise associated with construction could cause some temporary disturbance to wildlife, but this impact would be minimal since animals living adjacent to the F-Area have already adapted to similar disturbances. There would be no direct impacts to wetlands or aquatic resources from construction of the facility. Secondary impacts from stormwater runoff would be controlled by implementation of a soil erosion and sediment control plan. Operational impacts to wetlands and aquatic resources would be minimal since there would be relatively small increases in treated wastewater and storm water that would be discharged via NPDES-permitted outflows. Impacts from construction and operation of the three disposition facilities would not be expected to affect threatened and endangered species due to the developed nature of the assumed facility locations. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by these facilities. Before committing construction resources, DOE would consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate.

Construction of the MOX facility north of the P-Reactor Area on the east side of SRS Route F would affect animal populations. Less mobile animals within the project area, such as reptiles and small mammals, would not be expected to survive. Noise from construction and operation activities would cause larger mammals and birds in the construction area and adjacent areas to move to similar habitat nearby. Nests and young animals living with the assumed sites may not survive. The sites would be surveyed as necessary for the nests of migratory birds before construction. Areas disturbed by construction, but not occupied by facility structures, would be of minimal value to wildlife because they would be maintained as landscaped areas.

Since the majority of the assumed MOX fuel fabrication facility site is upland, the facility could be located to avoid direct impacts to wetlands. Wastewater discharge from construction and operation would be minimal and would not be expected to affect wetlands associated with the receiving stream. Stormwater runoff during construction could cause temporary water quality changes in local tributaries to Par Pond. During operation, nonhazardous wastewater flow increases are not expected to impact stream hydrology or aquatic resources. All discharges would be required to meet NPDES permit regulations.

It is unlikely that federally listed threatened or endangered species would be affected by construction or operation of a MOX fuel fabrication facility. Although bald eagles have been sighted in the vicinity of the assumed facility location, it is highly unlikely that construction and operation of the MOX fuel fabrication facility would affect this species. Although suitable foraging habitat for the red-cockaded woodpecker exists in the area, the woodpecker colonies are located far enough from the facilities so that this species would not be directly affected by the MOX facility. Before construction, preactivity surveys would be conducted as appropriate to determine the presence of any special status species and habitat on the proposed site; DOE would consult with Federal and State agencies pursuant to the ESA and other statutes as appropriate.

Cultural and Paleontological Resources

The impacts to cultural and paleontological resources are closely related to the amount of land disturbed. The land-use impacts associated with construction and operation of the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS are discussed under Land Resources. Because most of the locations proposed have been previously disturbed, it is unlikely that they would contain subsurface prehistoric or historic archaeological deposits. Some paleontological remains may be encountered during construction. Operations would not have additional impacts on historic, prehistoric, or paleontological resources, but there may be visual or auditory intrusions to Native American resources.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area. The pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would be located on vacant land in the 200 Area adjacent to 200 East. Although no archeological resources have been identified during surveys conducted in the adjacent 200 Areas, some may exist in the facility locations. Any such sites would be identified through compliance with Sections 106 and 110 of the *National Historic Preservation Act* of 1966 (NHPA). Any identified sites may be affected by facility construction. Operation would not result in additional impacts.

Although all of Hanford is considered sacred land by some Native American groups, no areas of great cultural significance have been identified close to the 200 Area. Resources may be identified through facility-specific consultation. Impacts from construction and operation may include reduced access to traditional use areas or visual or auditory intrusion into sacred or ceremonial space.

Pliocene and Pleistocene fossil remains have been discovered at Hanford. Although none have been recorded in the facility locations, they may exist. These resources may be affected by ground disturbing construction. Operations would not have additional impacts on paleontological resources.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at the ICPP and the ZPPR and FMF vaults in ANL-W. The pit disassembly/conversion and MOX facilities would be located on undeveloped land within or near the ICPP security area. The pit disassembly/conversion facility would be sited in a location previously approved for the construction of the Special Isotope Separation Project. A surface survey of this area identified no prehistoric or historic sites. Although it is possible, the ICPP is unlikely to contain intact subsurface cultural deposits, due to prior ground disturbance and environmental setting. INEL has a contingency plan in place should any archeological remains be discovered during construction. Two historic sites exist adjacent to the ICPP, one historic can scatter lies across the Big Lost River to the northeast, and one abandoned homestead is to the east. The can scatter is not considered eligible for National Register of Historic Places (NRHP) listing, and the homestead has been fenced off for protection. Construction and operation are not expected to affect either site.

Native American resources may be affected by the proposed facilities. Facility construction and operation may have visual or auditory impacts on traditional use areas or sacred sites. Resources may be identified through consultation with the interested tribes.

Some paleontological remains may be encountered during construction. The ICPP lies on alluvial gravels associated with the Big Lost River floodplain, which have produced fossilized remains. Operation would not have an effect on paleontological resources.

Pantex Plant. Modifications of Buildings 12-66 and 12-82 in Zone 12 South to accommodate the long-term storage of Pantex pits and RFETS pits are not considered NRHP eligible based on an evaluation of World War II Era structures at Pantex. However determinations of NRHP-eligible Cold War Era structures have not been completed, and some structures in Zone 12 may be determined eligible on that basis. Zone 12 is also the potential location for the pit disassembly/conversion facility. Because Zone 12 South is developed, disturbed, and removed from water sources, it is unlikely to contain subsurface prehistoric or historic archeological deposits, even on lands used for equipment laydown or construction parking. No impacts to prehistoric or historic resources are expected to result from the construction or operation of these facilities.

Areas that would be disturbed in Zone 11 for the MOX fuel fabrication facility have not been systemically surveyed for archaeological or paleontological resources. Before construction, additional survey work may be necessary under Section 106 of the NHPA. Because Zone 11 is disturbed, it is unlikely to contain subsurface prehistoric or historic archeological deposits. Should any subsurface remains be discovered during construction, appropriate mitigation, documentation, and/or preservation measures would be conducted as necessary. Operations would not have additional impacts to archeological resources as it does not result in additional ground disturbance. Facility construction may have an impact on historic structures at Pantex. The original buildings in Zone 11 were constructed between 1942 and 1945 to produce general purpose bombs. Zone 11 contains buildings, ramps, and landscape features that clearly illustrate the historic layout of a World War II bomb manufacturing line. Only two buildings within Zone 11 have been determined ineligible for listing on the NRHP. Construction may obscure the spatial relationship between these buildings, thereby compromising their historic significance. Operation of the facility is not expected to affect historic structures.

The Department has recently initiated consultation with Native American groups that have expressed interest in Pantex lands. To date, no Native American resources have been identified within Zones 11 and 12. Resources may be identified through additional consultation. Although no mortuary remains have been discovered at Pantex to date, it is possible that some exist within land to be disturbed by development. Burials are considered important Native American resources. Construction and operation could affect traditionally used plant and animal species.

The surficial geology of the Pantex area consists of silts, clays, and sands of the Blackwater Draw Formation. In other areas of the High Plains, this formation has produced Late Pleistocene vertebrate remains including woolly mammoth, bison, and camel, sometimes in context with archaeological remains. The land to be disturbed during construction may contain some fossilized remains. Operation would not have an affect on paleontological resources.

Savannah River Site. The Actinide Packaging and Storage Facility in F-Area would be modified to accommodate the storage of SRS non-pit Pu material and RFETS non-pit Pu material for the storage Preferred Alternative. Vacant land in the F-Area would be used for the pit disassembly/conversion, Pu conversion, and ceramic immobilization facilities. Portions of the F-Area have been surveyed and contain sites potentially eligible for the NRHP. Additional surveys would be conducted in any unsurveyed areas to be disturbed by construction. Site types known to occur at SRS include remains of prehistoric base camps, quarries, and workshops. Historic resources include remains of farmsteads, cemeteries, churches, and schools. Resources such as these may be affected by new facility construction, but not operation.

The MOX fuel fabrication facility would be located on undeveloped land approximately 1.6 km (1 mi) north of the P-Reactor Area on the east side of SRS Route F. To date, seven prehistoric sites have been located within 0.5 km (0.3 mi) of this area, so the potential for archaeological sites is moderate to high, and some NRHP-eligible resources may occur within the acreages that would be disturbed by construction. Prehistoric site types that may occur at SRS include villages, base camps, limited activity sites, quarries, and workshops. Historic site types that may occur at SRS include farmsteads, tenant dwellings, mills, plantations and slave quarters, rice farming dikes, cattle pens, dams, towns, churches, cemeteries, trash scatters, and roads.

Some Native American resources may be affected by construction and operation of the facilities. Resources such as prehistoric sites, cemeteries, isolated burials, and traditional plants could be affected by construction. Facility operation could result in reduced access to traditional use areas or sacred space. Visual or auditory intrusions to the areas may also result from the proposed facilities. These resources would be identified through consultation with the potentially affected tribes.

Some paleontological remains may occur on this acreage, but impacts during construction would be considered negligible because fossil assemblages known to occur at SRS are of low research value. No additional impacts are expected to paleontological resources during operation since no additional ground disturbance is expected.

Socioeconomics

At Hanford, INEL, Pantex, and SRS the primary impact of the Preferred Alternative would be to increase regional employment and income. There would be some increase in demand for community services and housing at each of the sites as a result of in-migrating population. However, the available housing and existing community infrastructure would be able to accommodate these small population increases. Construction and operation of the proposed facilities would increase traffic flow and cause a potential decline in the level of service on some road segments at all sites except Hanford. At RFETS, phaseout of Pu storage would result in the loss of approximately 2,200 direct jobs. Compared to the total employment in the area, the loss of these jobs and the impacts to the regional economy would not be severe.

Hanford Site. Plutonium materials would continue to be stored at the PFP in the 200 West Area, and there would be no impact on the site workforce. Construction of the pit disassembly/conversion, Pu conversion, ceramic immobilization, and MOX facilities would continue through the year 2013, and there would be sufficient available labor within the region to fulfill construction workforce requirements. Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total regional economic area (REA) employment would increase by 2001 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be fully operational, generating approximately 7,500 additional jobs in the REA.

In the year 2003, the pit disassembly/conversion and MOX facilities would be the first disposition alternative facilities to become fully operational. Pu conversion would begin in 2006, and the ceramic immobilization operations would begin in 2013. The operational workforce would increase beginning in the year 2003 and peak in the year 2013 when all of the disposition facilities would become fully operational. Total direct employment would reach approximately 3,100 in 2013. Total REA employment would increase by approximately 10,400, and unemployment would decrease from 9.1 to 7.1 percent. The per capita income would increase by 2 percent.

In-migration to fulfill specialized direct job requirements would lead to a population increase of about 1 percent in the ROI. The additional population would increase the demand for community services by approximately 1 percent. Demand for housing would also increase, but the impact on the local markets would be minimal.

Construction and operation workers at Hanford would generate 1,920 and 5,900 additional vehicle trips per day on the local roads, respectively. The level of service would not change due to the additional traffic generated during construction. Operations would cause a drop in level of service from B to C on Washington State Route 240 from Washington State Route 24 to Washington State Route 224.

Idaho National Engineering Laboratory. Plutonium materials would continue to be stored at ICPP and ZPPR, and in FMF vaults at ANL-W. No additional workforce would be required for continuation of the storage mission at INEL. Construction of the pit disassembly/conversion and MOX facilities would take place concurrently and continue through the year 2003. Some in-migration would take place both during construction and operation to fill specialized job requirements. Direct employment during peak construction would reach 660 in 1999 and total 1,330 during the first year of full operation in 2003. Total REA employment would increase by approximately 1,200 during construction and by approximately 6,000 during operations. Unemployment would decrease from 5.4 percent to 4.8 percent during peak construction and fall further to 2.4 percent during operation. The per capita income would increase by less than 0.4 percent during construction and by about 1.4 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of less than 1 percent in the ROI. The additional population would increase demand for community services by less than 1 percent during both construction and operations. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at INEL would generate 1,267 and 2,554 additional vehicle trips per day on local roads, respectively. The level of service would not change due to additional traffic generated during construction. Operations would cause a drop in level of service from D to E on US 20 from US 26/91 at Idaho Falls to US 26 East. Operations would also cause a drop in level of service from B to C on US 20/26 from US 26 East to Idaho State Route 22/33.

Pantex Plant. Buildings 12-66 and 12-82 would be modified to accommodate the long-term storage of Pantex pits and RFETS pits for the storage Preferred Alternative. Additional workers would be required for construction and operation of the modified storage facilities. Construction of the pit disassembly/conversion and MOX fabrication facilities would take place concurrently and continue through 2003, when full operations would commence. Because the construction of the disposition facilities would require a larger workforce than would modification of the storage facilities, peak construction impacts would occur in 1999. Peak operation impacts would occur in 2005, when all three facilities would be fully operational. Total direct construction employment during peak construction would reach 660 in 1999, and direct operation employment would reach 1,420 in 2005, when all three facilities would be fully operational. Total REA employment would increase by 1,192 during peak construction and by 6,404 during operations. Unemployment would decrease from 4.8 percent to 4.3 percent during peak construction and fall further to 3.0 percent during operations. The per capita income would increase about 0.3 percent during construction and by 0.5 percent during operations.

In-migration to fulfill direct job requirements for both construction and operations would lead to a population increase of 0.1 percent during construction and about 2 percent during operation. The increase in demand for community services during construction and operation would be minimal. Demand for housing would also increase, but, the impact on the local markets would be minimal.

Construction and operation workers at Pantex would generate 1,267 and 2,726 additional vehicle trips per day on local roads, respectively. The level of service would not change due to additional traffic generated during construction. Operations would cause a drop in level of service from A to B on Farm-to-Market 683 from US 60 to Farm-to-Market 293 and on Farm-to-Market 2373 from I-40 to US 60.

Savannah River Site. Under the Preferred Alternative, the Actinide Packaging and Storage Facility in the F-area would be modified to accommodate the long-term storage of the SRS non-pit Pu material and RFETS non-pit Pu material. The modification activities would employ workers from the current workforce, while operation of the expanded storage facility would require some additional workers. Construction of the pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and the ceramic immobilization facilities would continue until 2013, when all of the facilities would become operational. There would be sufficient available labor in the region to fulfill the construction workforce requirements. Economic impacts from construction would peak in 2010, during construction of the ceramic immobilization facility. Total REA employment would increase by 1,793 due to construction of the ceramic immobilization facility. However, during this same period, the other three disposition facilities would already be operating and generating an additional 6,936 jobs in the REA. Peak economic impacts would occur in 2013, when all of the storage and disposition facilities would be fully operational. Total employment in the region would increase by 9,482, and unemployment would decrease to 4.5 percent. Regional per capita income would increase by about 1.6 percent.

Because of the demand for in-migrating workers to fill specialized employment requirements, the ROI population would increase by 0.9 percent. Demand for community services would increase about 1 percent or less. The increase in demand for housing would be too small to affect the market.

Construction and operation workers at SRS would generate 1,920 and 6,150 additional vehicle trips per day on local roads, respectively. Construction would cause a drop in level of service from E to F on South Carolina State Route 19 from US 1/78 at Aiken to US 278. Operations would not significantly impact local roads.

Public and Occupational Health and Safety

Normal Operations. The human health impacts from the radiological and hazardous chemical releases during facility normal operations associated with the storage and disposition Preferred Alternative actions were analyzed at each of the DOE sites. The impact of the Preferred Alternative actions were then combined to obtain the "total impact." Total impact for each receptor/impact parameter is the summation of each facility, action, process, or technology for each of the operational campaigns (the number of years required to complete Pu disposition). Under normal radiological operations, the annual incremental dose to the maximally exposed individual (MEI) ranges from $2.7x10^{-4}$ millirem (mrem)/yr at INEL to $4.1x10^{-3}$ mrem/yr at SRS. All doses, when added to No Action, are within the radiological limits specified in NESHAPS (40 CFR 61, Subpart H) and DOE Order 5400.5. The annual incremental dose to the population within 80 km (50 mi) from the Preferred Alternative ranges from $4.2x10^{-3}$ person-rem/yr at INEL to 0.22 person-rem/yr at SRS. For DOE activities, proposed 10 CFR 834 (See 58 FR 1628) would generally limit the potential annual population dose to 100 person-rem from all pathways combined, and would require an As Low As Reasonably Achievable Program. When the contribution from the Preferred Alternative is combined with the No Action population dose for each of the sites, the total dose is well within the proposed 10 CFR 834. The dose assessments of the involved worker for storage and disposition facilities are within DOE radiological limits and administrative control levels. The incremental latent cancer fatalities to the involved workforce statistically estimated from these doses attributed to the Preferred Alternative range from 0.48 at INEL to 1.32 at SRS for the entire campaign (estimates based on the *1990 Recommendations of the International Commission of Radiological Protection*).

Facility Accidents. A set of potential accidents was postulated for each component of the Preferred Alternative. For each DOE site subject to multiple storage and disposition actions (Hanford, INEL, Pantex, and SRS), this includes a set of accidents for the storage option coupled with the combination of preferred disposition technologies assumed for the analysis. For the Existing LWR Alternative, a Probabilistic Risk Assessment (PRA) approach was applied to determine the effects of operating an existing LWR with a MOX core. The incremental effects are described below.

One measure of impact calculated from modeled accident scenarios is expected risk, the summation of risk (the product of accident occurrence probability and consequence) for the accident spectrum modeled for each component of the Preferred Alternative. These expected risks were aggregated for the Preferred Alternative for the following impact receptors: a worker located 1,000 m (3,280 ft) from the accident release point; the maximum hypothetical offsite individual located at the site boundary; and the population located within 80 km

(50 mi) of the accident release point. Aggregated expected risk estimates of cancer fatality(s) for each assumed campaign under the Preferred Alternative range from: $1.3x10^{-6}$ at INEL to $1.5x10^{-5}$ at Pantex; $1.4x10^{-8}$ at INEL to $6.0x10^{-6}$ at Pantex; and $3.0x10^{-5}$ at INEL to $9.1x10^{-4}$ at Pantex; respectively for these impact receptors. The Y–12 upgrade at ORR under the Preferred Alternative could reduce the expected risk of cancer fatalities for the design basis accidents analyzed in the Y–12 EA to $5.1x10^{-7}$, $7.4x10^{-6}$, and $5.7x10^{-8}$ per year for the 80-km (50-mi) offsite population, MEI, and noninvolved worker, respectively by meeting the performance goal for a moderate hazard facility of Performance Category 3 as prescribed in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation.*

The evaluated accident scenario with the highest risk to the public at the DOE sites under the Preferred Alternative (a fire on the loading dock of the MOX fuel fabrication facility) would result in an estimated risk of $5.2x10^{-5}$, $1.6x10^{-5}$, $1.8x10^{-5}$, and $5.2x10^{-5}$ cancer fatalities over the assumed MOX fuel fabrication campaign at Hanford, INEL, Pantex, and SRS, respectively.

Under the Preferred Alternative, the use of existing LWRs is being pursed for the disposition of surplus plutonium through the use of MOX fuel in place of UO_2. An important question is whether the use of MOX fuel changes the safety envelope of UO_2 fueled reactors documented in Safety Analysis Reports, PRAs, and NUREG-1150 (*Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*). Related reactor safety issues are addressed in a recent report by the National Academy of Sciences (*Management and Disposition of Excess Weapons Plutonium Reactor-Related Options*). The report indicates that the potential influences on safety of the use of MOX fuel in LWRs has been extensively studied in the United States in the 1970s (*Final Generic Environmental Impact Statement on the Use of Recycled Plutonium in Mixed Oxide Fuel in Light Water Cooled Reactors*, NUREG-0002). These influences have also been extensively studied in Europe, Japan and Russia. Regarding effects of MOX on accident probabilities, the National Academy of Sciences report states, "... no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel." Regarding the effects of MOX on accident consequences, the report states, "... it seems unlikely that the switch from uranium-based fuel could worsen the consequences of a postulated (and very improbable) severe accident in a LWR by more than 10 to 20 percent. The influence on the consequences of less severe accidents, which probably dominate the spectrum value of population exposure per reactor-year of operation would be even smaller, because less severe accidents are unlikely to mobilize any significant quantity of plutonium at all."

The incremental effects of utilizing MOX fuel in a commercial reactor in place of UO_2 were derived from a quantitative analysis of several typical severe accident scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers highly unlikely severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic offsite population located within 80 km (50 mi) of the severe accident release point would range from $-2.0x10^{-4}$ to $3.0x10^{-5}$ per year for the accident release scenarios analyzed.[18] These preliminary results would be re-examined for licensing purposes and subsequent NEPA review. More detailed safety analyses would be performed using both up-to-date calculations of radionuclide inventories for different fuel compositions and irradiation histories, and population-exposure models for sensitivity changes in those inventories resulting from the use of weapons-grade Pu in the fuel.

[18] Accidents severe enough to cause a release of Pu or HEU involve combinations of events that are highly unlikely. Estimates and analyses presented in Chapter 4 and summarized in Table 2.5–3 indicate a range of latent cancer fatalities of $5.9x10^3$ to $7.3x10^3$ and risk per year of 0.15 to 0.16.

Natural Phenomena. Under the Preferred Alternative, HEU would continue to be stored at the Y–12 Plant at ORR in existing facilities that would be upgraded. The majority of the HEU would be housed in upgraded facilities currently used for HEU storage. The remaining HEU would be stored in facilities that were formerly used for material processing but are currently being modified and converted into storage areas. Modifications to existing buildings would make the facilities suitable for long-term storage and consist primarily of those upgrades required to meet natural phenomena requirements (including earthquakes and tornadoes) as documented in *Natural Phenomena Upgrade of the Downsized/Consolidated Oak Ridge Uranium/Lithium Plant Facilities* (Y/EN-5080, 1994). The Y–12 storage buildings would be upgraded to meet the performance goal for a moderate hazard facility of Performance Category 3 in DOE Order 5480.28, *Natural Phenomena Hazards Mitigation*. In a Performance Category 3 facility, radioactive or toxic materials are present in significant quantities. Design considerations for this category are to limit facility damage so that hazardous materials can be controlled and confined, occupants can be protected, and functions of the facility can continue without interruption. A performance goal for Performance Category 3 is a hazard exceedance frequency of $1.0x10^{-4}$ per year (DOE Order 5480.28). Meeting this performance goal would reduce the expected risk for the design basis accidents analyzed in the Y–12 EA (for example, Building 9212) by approximately 80 percent, resulting in a latent cancer fatality risk of $5.1x10^{-7}$ to the MEI and $5.7x10^{-8}$ to a noninvolved worker, and potential latent cancer fatalities of $7.4x10^{-6}$ for the 80-km (50-mi) offsite population.

At SRS, F-Canyon facilities could be used for the immobilization of surplus Pu using the can-in-canister variant under the Preferred Alternative. The earthquake accident analysis in the IMNM EIS determined that the F-Canyon facilities are structurally sound. Since that time, DOE has prepared a *Supplemental Analysis of Seismic Activity on F-Canyon* (August 1996). Based on the evaluation, an earthquake that could occur about once every 8,000 years could cause a level of structural damage to F-Canyon similar to the level of damage attributed to the earthquake considered in the IMNM EIS. Thus, the capability of F-Canyon to survive an earthquake more severe than that evaluated in the EIS, in combination with the fact that the likelihood of this level of damage was less than assumed in the EIS (1 per 8,000 years compared to 1 per 5,000 years), indicates that F-Canyon is seismically safe, or safer, than indicated in the IMNM EIS.

Waste Management

There is no spent nuclear fuel or HLW associated with construction or operation of Preferred Alternative facilities, but the ceramic immobilization facility would generate as its product output a stabilized ceramic form spiked with cesium radionuclides. (For immobilization using vitrification, a stable glass form of Pu and HLW would be generated.) Storage of this immobilized product would be provided until disposal in a geologic repository pursuant to the NWPA.[19] Each of the facilities under the Preferred Alternative have as part of their conceptual design waste management facilities that would treat and package all waste generated into forms that would enable long-term storage and/or disposal in accordance with the regulatory requirements of *Resource Conservation and Recovery Act* (RCRA), and other applicable statutes. Under the Preferred Alternative, the waste management infrastructure of the individual facilities would be integrated into a single waste management infrastructure to include maximum use of existing and planned site waste management facilities. Depending in part on decisions in the waste-type specific RODs for the Waste Management PEIS, wastes could be treated, and (depending on the type of waste) disposed of, onsite or at regionalized or centralized DOE sites. The treatment level and potential disposal of TRU and mixed TRU waste at the Waste Isolation Pilot Plant (WIPP) will depend on decisions in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*. For the purposes of analyses only, this PEIS assumes that transuranic (TRU) and TRU mixed waste would be treated onsite to the current planning-basis Waste Isolation Pilot Plant (WIPP) Waste

[19] Pursuant to the *Nuclear Waste Policy Act*, DOE is currently characterizing the Yucca Mountain Site as a potential repository for spent nuclear fuel and HLW. Legislative clarification, or a determination by the Nuclear Regulatory Commission that the immobilized Pu should be isolated as HLW, may be required before the material could be placed in Yucca Mountain should DOE and the President recommend, and Congress approve, its operation. No radionuclides that are RCRA wastes would be used for immobilization so the immobilized product would be consistent with the repository's waste acceptance criteria.

Acceptance Criteria, and shipped to WIPP for disposal. This PEIS also assumes that hazardous waste, low-level waste (LLW), and mixed LLW would be treated and disposed of in accordance with current site practice.

Construction and operation of the proposed facilities would affect existing waste management activities at each of the sites analyzed, increasing the generation of TRU, low-level, mixed, hazardous, and nonhazardous wastes. Wastes generated during construction would consist of wastewater and hazardous and solid nonhazardous wastes. Wastewater and solid nonhazardous wastes would be disposed of as part of the construction project by the contractor, and the hazardous wastes would be treated onsite or shipped offsite, to a commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in a commercial RCRA-permitted disposal facility. No radioactive or hazardous soil contamination is expected to be generated during construction. However, if any were generated, it would be managed in accordance with site practice and all applicable Federal and State regulations.

Hanford Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment, and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the Hanford Tri-Party Agreement to meet the WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,590 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the 200-Area LLW Burial Grounds. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 3,400 m^3/ha (1,800 yd^3/acre), this would require 0.6 ha/yr (1.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (320 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the Hanford Tri-Party Agreement. The 46 m^3 (12,150 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in Department of Transportation (DOT)-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 177,000 m^3 (46.8 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45.0 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 3,240 m^3 (4,240 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Richland landfill per current site practice.

Idaho National Engineering Laboratory. Under the Preferred Alternative approximately 373 m^3 (488 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the INEL Site Treatment Plan to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,100 gal) of liquid and 255 m^3 (333 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the Radioactive Waste Management

Complex (RWMC). Assuming a land usage of factor of 6,200 m^3/ha (3,300 yd^3/acre), the disposal of LLW would require 0.04 ha/yr (0.1 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.1 m^3 (290 gal) of liquid and 40 m^3 (52 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the INEL Site Treatment Plan. The 6 m^3 (1,500 gal) of liquid and 154 m^3 (201 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 129,000 m^3 (34.0 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new sanitary, utility, and process wastewater treatment facilities may be required. The 253 m^3 (331 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the onsite landfill per current site practice.

Pantex Plant. Under the Preferred Alternative approximately 374 m^3 (489 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 8 m^3 (11 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan* to meet the WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 44 additional truck shipments per year or, if applicable, 22 regular train shipments per year, or 7 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 8 m^3 (2,100 gal) of liquid and 392 m^3 (513 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the NTS Area 5 Radioactive Waste Management Site Waste Acceptance Criteria. After treatment and volume reduction, 324 m^3 (424 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 6,000 m^3/ha (3,200 yd^3/acre), the disposal of LLW would require 0.05 ha/yr (0.13 acres/yr) of LLW disposal area at NTS. Assuming 16.6 m^3 (21.7 yd^3) of LLW per shipment, 20 additional LLW shipments per year from Pantex to NTS would be required. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.3 m^3 (350 gal) of liquid and 48 m^3 (63 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the *Pantex Plant Federal Facility Compliance Act Site Treatment Plan/Compliance Plan*. The 7 m^3 (1,760 gal) of liquid and 155 m^3 (203 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 141,000 m^3 (37.2 million gal) of liquid nonhazardous sanitary, industrial, and other process wastewater would require treatment in accordance with site practice. Depending on site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The existing sanitary wastewater treatment system has adequate excess capacity to treat the additional quantity of sanitary wastewater. The 391 m^3 (511 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to the City of Amarillo landfill per current site practice.

Savannah River Site. Under the Preferred Alternative approximately 78.2 m^3 (20,660 gal) of liquid and 750 m^3 (981 yd^3) of solid TRU waste would require treatment and packaging to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. An estimated 200 m^3 (262 yd^3) of solid mixed TRU waste would be managed and treated as necessary in accordance with the SRS Treatment Plan to meet the current planning-basis WIPP Waste Acceptance Criteria or an alternate treatment level. Depending on decisions made in the ROD for the *Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant Disposal Phase*, 109 additional truck shipments per year or, if applicable, 54 regular train shipments per year, or 18 dedicated train shipments per year would be required to transport the TRU and mixed TRU waste to WIPP.

Approximately 70.4 m^3 (18,600 gal) of liquid and 2,010 m^3 (2,630 yd^3) of solid LLW would require treatment, processing, and packaging to meet the waste acceptance criteria of the SRS E-Area Low-Level Radioactive Disposal Facility. After treatment and volume reduction, 2,010 m^3 (2,630 yd^3) of solid LLW would require disposal. Assuming a land usage of factor of 8,600 m^3/ha (4,600 yd^3/acre), this would require 0.2 ha/yr (0.5 acres/yr) of LLW disposal area. The ultimate disposal of LLW will be in accordance with the ROD for the Waste Management PEIS.

Roughly 1.2 m^3 (311 gal) of liquid and 231 m^3 (302 yd^3) of solid mixed LLW would be treated and disposed of in accordance with the SRS Site Treatment Plan. The 46 m^3 (12,070 gal) of liquid and 184 m^3 (241 yd^3) of solid hazardous wastes would be collected, treated on- or off-site, and shipped in DOT-approved containers to an offsite commercial RCRA-permitted treatment facility. After treatment, the waste would be disposed of off-site in commercial RCRA-permitted disposal facilities.

Approximately 179,000 m^3 (47.3 million gal) of liquid nonhazardous sanitary and industrial wastewater and 170,000 m^3 (45 million gal) of steam plant and cooling blowdown and estimated stormwater runoff would require treatment in accordance with site practice. Depending on actual site location, expansion of existing or construction of new utility and process wastewater treatment facilities may be required. The centralized sanitary wastewater treatment system is adequate to treat the sanitary portion. The 3,250 m^3 (4,250 yd^3) of solid nonhazardous wastes that is not recycled or salvageable would be shipped to an offsite landfill per current site practice.

Intersite Transportation

The estimated health effects from transportation of radiological materials for the Preferred Alternative actions at Hanford, INEL, Pantex, and SRS for the life of the project range from 0.193 fatalities for Pantex to 1.87 fatalities for SRS.

In addition to the activities at the DOE sites, there would be transportation of the MOX fuel from the DOE fuel fabrication site to existing LWRs. The location of the LWRs and the destination of the MOX fuel could be either the eastern or western United States. For 4,000 km (2,486 mi) there could be an additional 3.61 potential fatalities. The 3.61 potential fatalities assumes that 100 percent of the surplus Pu would be used in commercial reactors. For analysis purposes, approximately 70 percent of the surplus Pu would be used in commercial reactors under the Preferred Alternative, therefore potential fatalities could be lower.

Environmental Justice

There would be no high and adverse health or environmental impacts to any population around the sites, including low-income and minority populations, from normal operation of the Preferred Alternative actions. The alternatives would confer socioeconomic benefits to each site where storage or disposition activities would occur (except RFETS), and therefore would not lead to any environmental justice concerns.

For environmental justice impacts to occur, there must be high and adverse human health or environmental impacts that disproportionately affect minority populations or low-income populations. The public health and safety analysis shows that air emissions and hazardous chemical and radiological releases from normal operations for all storage and disposition alternatives would be within regulatory limits and that no latent cancer fatalities would result.

The public health and safety analyses also indicate that radiological releases from accidents would not result in significant adverse human health or environmental impacts. Therefore, such accidents would not have disproportionately high and adverse impacts on minority or low-income populations. For the Preferred Alternative, for accidents associated with existing LWRs using MOX fuel, the maximum risk (which includes accident probability) of latent cancer fatalities to the public within 80 km (50 mi) would be 0.10 for the 11-year Pu disposition campaign. Therefore, it is unlikely that there would be disproportionately high and adverse impacts to minority populations or low-income populations surrounding the LWRs. Any potential transportation accidents would be random events that would not disproportionately affect minority or low-income populations.

S.7 CUMULATIVE IMPACTS

Cumulative impacts are those that could result from the incremental impact of the proposed action and alternatives identified above when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. The reference condition is the No Action Alternative, which addresses the impacts of past, present, and ongoing programs. In particular, for alternatives that are proposed for DOE sites, the analysis focuses on the potential for cumulative impacts at each candidate site where other programs are reasonably anticipated.

The reasonably foreseeable future actions that have the potential to be implemented at some of the DOE sites under consideration, in addition to the long-term storage and disposition alternatives considered in the Storage and Disposition PEIS, include the following DOE programs: Waste Management (at Hanford, NTS, INEL, Pantex, ORR, SRS, RFETS, and LANL); Stockpile Stewardship and Management (at NTS, Pantex, ORR, SRS, and LANL); Tritium Supply and Recycling (at SRS); HEU Disposition (at ORR and SRS); Foreign Research Reactor Spent Nuclear Fuel (at INEL and SRS); and Spent Nuclear Fuel Management (at Hanford, INEL, and SRS).

[Text deleted.]

LONG-TERM STORAGE

Long-Term Storage Alternatives

The cumulative impact analysis, including the long-term storage alternatives and the six other reasonably foreseeable DOE programs, identified the following resource areas and issues at each site as having the potential to result in cumulative impacts:

- At Hanford, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, air quality, biological resources, and waste management.

- At NTS, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, and waste management.

- At INEL, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, air quality, biological resources, socioeconomics (local transportation), and waste management.

- At Pantex, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, site infrastructure, air quality, water resources, and waste management.

- At ORR, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources (visual quality), air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At SRS, potential cumulative impacts from the maximum case alternative (Collocation) were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), public and occupational health and safety, and waste management.

- At RFETS, potential cumulative impacts from the maximum case alternative (Phaseout) were identified for socioeconomics.

- At LANL, no potential cumulative impacts were identified.

Preferred Alternative

The contribution to long-term storage cumulative impacts from the Preferred Alternative would be lower than the impacts identified above for the maximum case alternative at any one DOE site. Based on the cumulative impact analysis for long-term storage described above, the following resource and issue areas were identified at each site as having the potential to result in cumulative impacts:

- At Pantex, potential cumulative impacts were identified for land resources, site infrastructure, air quality, water resources, and waste management.

- At ORR, potential cumulative impacts were identified for air quality, cultural resources, local transportation, and waste management.

- At SRS, potential cumulative impacts were identified for air quality, public and occupational health and safety, and waste management.

- At RFETS, potential cumulative impacts were identified for socioeconomics.

Because the Preferred Alternative for storage at Hanford, NTS, INEL, and LANL is No Action, the storage program would not contribute to the cumulative impacts at these sites.

DISPOSITION

Disposition Alternatives

A site-specific cumulative impact analysis was not performed for all of the disposition alternatives because many of the facilities (for example, deep borehole complex and existing LWRs) do not allow site-specific cumulative impact analysis. Instead, a generic analysis that is applicable to all DOE sites was developed for these disposition alternatives. This representative scenario includes all of the common activities that would be needed for all of the disposition alternatives (construction and operation of pit disassembly/conversion and Pu conversion facilities), the common activity that would be required for the reactor alternatives (construction and operation of a MOX fuel fabrication facility), and the immobilization alternative that would generally have the largest impacts (ceramic immobilization facility). The scenario assumes that all four of the facilities would be constructed and operated concurrently at the same DOE site. Potential cumulative impacts could result from constructing and operating the pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and immobilization facilities at a single DOE site.

For land resources, the construction of all four of the disposition facilities would disturb up to 191 ha (472 acres) of land during construction, of which up to 133 ha (330 acres) would be used during operations. If all four of the facilities were located at the same site, there would likely be a reduced area of disturbed land due to the sharing of land resources. Construction and operation of the disposition facilities could also result in the direct disturbance of terrestrial resources, wetlands, and threatened and endangered species.

The construction and operation of the disposition facilities could affect cultural and paleontological resources by disturbing Native American and buried paleontological materials. Constructing and operating the disposition facilities would generate employment and income increases in the region.

During normal operations of the disposition facilities, there would be both radiological and chemical releases to the environment and direct in-plant worker exposures. However, exposures are expected to be within regulated limits. To the extent possible, existing treatment systems would be used for the waste streams from the disposition facilities. If the capacity or appropriate treatment technology are not available, new treatment facilities would be built to handle the waste from the new facilities.

Preferred Alternative

Under the Preferred Alternative for disposition, Hanford and SRS are potential sites for four facilities (pit disassembly/conversion, Pu conversion, MOX fuel fabrication, and immobilization), therefore, the maximum contribution to cumulative impacts would result at these sites if all four facilities were constructed. INEL and Pantex are potential sites for two facilities (pit disassembly/conversion and MOX fuel fabrication), therefore, the maximum contribution to cumulative impacts at these sites would result if both of these facilities were constructed. Based on the cumulative impact analysis for the disposition alternatives described above, the following resource areas and issues were identified as having the potential to result in cumulative impacts:

- At Hanford, potential cumulative impacts were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At INEL, potential cumulative impacts were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At Pantex, potential cumulative impacts were identified for land resources, site infrastructure, air quality, water resources, cultural and paleontological resources, socioeconomics (local transportation), and waste management.

- At SRS, potential cumulative impacts were identified for land resources, site infrastructure, air quality, biological resources, cultural and paleontological resources, socioeconomics (local transportation), public and occupational health and safety, and waste management.

S.8 COMPARISON OF ALTERNATIVES

The environmental impacts of the storage and disposition alternatives, including the Preferred Alternative, are compared in this section. The emphasis is on those environmental resources and issues that discriminate between the alternatives and are of interest to the public. Detailed comparison tables, including each alternative and each resource and issue, are contained in Chapter 2 of the PEIS. Within this Chapter, Table 2.5–1 provides a summary of environmental impacts for the Preferred Alternative for storage; Table 2.5–2 provides a comparison of environmental impacts for the No Action and long-term storage alternatives; and Table 2.5–3 provides a comparison of environmental impacts for disposition alternatives (including the Preferred Alternative).

LONG-TERM STORAGE

Tables S.8–1 through S.8–6 present a comparison of the key environmental impacts for the long-term storage alternatives and the Preferred Alternative for storage. As discussed in Section S.2, the Preferred Alternative for storage is a combination of No Action and Upgrade Alternatives for the various DOE sites, and phaseout of Pu storage at RFETS.

For all of the storage sites, the No Action Alternative is used as a baseline from which incremental impacts of the storage alternatives are compared. The phaseout associated with these storage alternatives could reduce human health and waste generation impacts and increase the number of lost jobs at some sites.

Site Infrastructure. For the Upgrade Alternatives, all requirements would be within existing site capacities for all sites except for coal at ORR and SRS. Under the Preferred Alternative, coal consumption at ORR and SRS would exceed site storage capacities by less than 1 percent; all other requirements would be within existing site capacities. In those cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 0 to 104 percent (maximum for Pantex); peak electric load, 0 to 90 percent (maximum for Pantex); oil, 0 to 13 percent (maximum for INEL for the Upgrade Alternative); natural gas, 0 to 71 percent (maximum for Pantex); and coal, 0 to 1 percent (maximum for ORR).

For the Consolidation Alteratives, all requirements would be within existing site capacities at all sites except for the following: electrical energy (12 percent over existing capacity), oil (1 percent over existing capacity), and natural gas (no existing capacity) at NTS; coal at INEL (97 percent over existing capacity); and oil (1 percent over existing capacity) and coal (2 percent over existing capacity) at SRS. In these cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 8 to 104 percent (maximum for Pantex); peak electric load, 9 to 90 percent (maximum for Pantex); oil, 1 to 5 percent (maximum for Pantex); natural gas, 0 percent (no existing capacity at NTS); and coal, 0 to 97 percent (maximum for INEL). All infrastructure requirements could be met by increasing procurement or, in the case of NTS, by using a different energy source.

For the Collocation Alternatives, all requirements would be within existing site capacities at all sites except for the following: electrical energy (21 percent over existing capacity), oil (1 percent over existing capacity), and natural gas (no existing capacity) at NTS; coal at INEL (124 percent over existing capacity); oil (3 percent over existing capacity), and coal (35 percent over existing capacity) at ORR; and oil (1 percent over existing capacity) and coal (3 percent over existing capacity) at SRS. In these cases where site capacity for fuel storage does not adequately support increased requirements, more frequent deliveries would be scheduled. Increases in resource requirements would be within the following ranges over No Action: electrical energy, 8 to 126 percent (maximum for Pantex); peak electric load, 9 to 100 percent (maximum for Pantex); oil, 1 to 14 percent (maximum for ORR); natural gas, 0 percent (no existing capacity at NTS); and coal, 0 to 124 percent (maximum for INEL).

Soil, Cultural, and Paleontological. Ground disturbance during construction activities would potentially impact soil; cultural resources (including historic, prehistoric, and Native American); and paleontological resources. The Upgrade Alternatives and the Preferred Alternative would have fewer impacts because they use existing facilities or involve only small areas of ground disturbance. The Consolidation and Collocation Alternatives would have more impacts because they involve more ground disturbance due to the construction of new facilities.

Land Use and Visual Resources. For land use, the larger facilities associated with Consolidation and Collocation Alternatives would use more land (56 to 87 ha [138 to 215 acres]) than the facilities associated with Upgrade and Preferred Alternatives (0 to 0.1 ha [0 to 0.25 acres]). The Collocation Alternative at ORR would change the current VRM Class 4 designation of the Bear Creek Road/Route 95 intersection to Class 5. Visual resources at the other DOE sites would not be affected by the storage alternatives because the facilities would be located near other similar structures.

Air Quality and Noise. Since the Collocation and Consolidation Alternatives would result in more air emission sources (exhaust from delivery trucks, generators, and boilers), slightly greater air quality impacts would occur than with the Upgrade and Preferred Alternatives. The more extensive ground disturbance during construction associated with the Consolidation and Collocation Alternatives would also result in higher levels of PM_{10} and TSP than for the Upgrade and Preferred Alternatives. Potential air emissions for all of the alternatives are within applicable Federal, State, and local air quality standards and guidelines. Minimal noise impacts would be expected from the storage alternatives because of the remote location of the facilities that would be modified or constructed.

Socioeconomics. Beneficial impacts to regional employment would be expected from all storage alternatives at all storage sites (Table S.8–1) except for the site (or sites depending on the alternative) where storage would be phased out. Collocation would generate the largest employment, followed by the Consolidation, Upgrade, and Preferred Alternatives. However, the phaseout at RFETS associated with the Preferred Alternative would result in the loss of approximately 2,200 direct jobs. Due to the small number of the new jobs created by the alternatives relative to the size of the regional economies at all of the DOE sites, community services would not be affected by the long-term storage alternatives. Short-term local transportation impacts may result at all sites from the construction of the facilities associated with the storage alternatives. The larger construction projects (Collocation and Consolidation Alternatives) would have a greater potential to cause short-term congestion on local roads than the smaller construction projects (the Upgrade and Preferred Alternatives).

Table S.8–1. Maximum Incremental Direct Employment Over No Action Generated During Operations at Each Candidate Site

Site	Total Site Employment in 2005	Upgrade	Consolidation	Collocation	Preferred Alternative
Hanford	14,586	252[a]	443	572	0
NTS	3,800	NA	527[b]	641[b]	0
INEL	6,911	116[a]	432	561	0
Pantex	3,559	90[c]	509[d]	601	90[e]
ORR	18,010	111	[f]	566[g]	111
SRS	16,562	30[h]	485	614	30[h,i]

[a] Upgrade with RFETS and LANL materials.
[b] Modify P-Tunnel.
[c] Upgrade with RFETS and LANL materials. Actual number of employees during operation could be higher.
[d] Construct new and modify existing storage facilities.
[e] Upgrade with pits from RFETS.
[f] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[g] Construct new Pu and HEU facilities.
[h] Workers would be supplied from existing site workforce.
[i] Upgrade with non-pit materials from RFETS.
Note: NA=not applicable.

Water Resources. The water resource impacts for the Consolidation and Collocation Alternatives are greater than for the Upgrade and Preferred Alternatives, both in water requirements and wastewater discharges. Wastewater discharge is dependent on the number of employees, which is greatest for the Consolidation and Collocation Alternatives due to the larger facilities. As shown in Table S.8–2, water resource requirements are the greatest for the Collocation Alternative at all DOE sites because collocation includes the maximum amount of Pu and HEU in the PEIS. Water resource requirements for all the alternatives would impact groundwater availability at Pantex because the additional groundwater withdrawal would contribute to the existing overall decline in water levels of the Ogallala Aquifer. However, there should be minimal impacts to regional groundwater levels from this additional withdrawal. At all other sites, water requirements would have minimal impact on water resources because of the abundance of surface water or groundwater.

Table S.8–2. Maximum Annual Net Incremental Water Usage Over No Action During Operation at Each Candidate Site

Site	No Action in 2005 (MLY)	Upgrade (MLY)	Consolidation (MLY)	Collocation (MLY)	Preferred Alternative (MLY)
Hanford	195	8.9[a]	110	150	0
NTS	2,400	NA	130[b]	190[b]	0
INEL	7,570	22[a]	66	87	0
Pantex	249	110[a]	110[c]	130	27.5[d]
ORR	14,760	0.24	[e]	360[f]	0.24
SRS	13,247	7.1[a]	360	460	5.7[g]

[a] Upgrade with RFETS and LANL materials.
[b] Modify P-Tunnel.
[c] Construct new and modify existing storage facility.
[d] Upgrade with pits from RFETS.
[e] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[f] Construct new Pu and HEU facilities.
[g] Upgrade with non-pit materials from RFETS.
Note: MLY=million liters per year; NA=not applicable.

Biological Resources. The Preferred Alternative would have no incremental biological resource impacts at INEL and Hanford, and minimal impacts at Pantex and potentially at SRS because of ground disturbance for upgrades. The Consolidation and Collocation Alternatives would have the potential to impact biological resources at all DOE sites because they would involve ground disturbance. At Pantex, previously disturbed land would be used for consolidation and collocation facilities. Threatened and endangered species at NTS and SRS may be affected by the storage alternatives at these sites.

Environmental Justice. All six DOE storage sites have, within an 80-km (50-mi) radius, census tracts with greater than 25 percent minority or low-income populations. However, the public health and safety analyses show that air emissions and hazardous chemical and radiological releases from normal operations for all storage alternatives would be within regulatory limits and that no latent cancer fatalities would result. The public health and safety analyses also indicate that radiological releases from accidents would not result in disproportionate and adverse human health or environmental impacts. Potential transportation accidents would be random events along transportation corridors. Therefore, none of the storage alternatives would have disproportionately high or adverse impacts on minority or low-income populations.

Waste Management. All of the storage alternatives would impact existing waste management practices at the DOE sites by increasing the amount of waste that must be treated, stored, and disposed. Depending on decisions in the waste-type-specific RODs for the Waste Management PEIS, wastes would be treated and disposed of onsite or at regionalized or centralized DOE sites. Generally, the Consolidation and Collocation Alternatives would generate more wastes than the Upgrade and Preferred Alternatives. Tables S.8–3 through S.8–5 show the maximum incremental waste generation rates for solid TRU, solid low-level, and solid hazardous wastes at the six candidate sites.

Public and Occupational Health and Safety. Table S.8–6 shows the differences between the long-term storage alternatives for radiological exposures to the public. The maximum potential latent cancer fatalities over No

Action for the MEI over 50 years from normal operations ranges from 4.5×10^{-13} for the Upgrade and Preferred Alternatives at Pantex to 1.1×10^{-9} for the Collocation Upgrade Alternative at ORR. This means that the chance of a latent cancer fatality occurring ranges from about 1 in 1 billion to 5 in 10 trillion. The risk varies because of site parameters including the distance from the facility to the MEI (small sites vs. large sites); local meteorological conditions (windspeed, direction, and stability); and the type of material being stored (metals and oxides vs. residues).

Table S.8–3. Maximum Annual Net Incremental Volume of Solid Low-Level Waste Over No Action Generated During Operations at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	3,390	89[a]	1,260	1,300	0
NTS	15,000	NA	1,260	1,300	0
INEL	7,200	500[a]	1,260	1,300	0
Pantex	32	1,260[a]	1,260	1,300	138[b]
ORR	7,320	3	[c]	1,300[d]	3
SRS	16,400	0	1,220[e]	1,260[e]	0

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[d] Construct new Pu and HEU facilities.
[e] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table S.8–4. Maximum Annual Net Incremental Volume of Solid Transuranic Waste Over No Action Generated During Operations at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	271	21[a]	10	10	0
NTS	0	NA	10	10	0
INEL	3.5	2[a]	10	10	0
Pantex	0	10[a]	10	10	0.8[b]
ORR	119	0	[c]	10[d]	0
SRS	338	0	2[e]	2[e]	0

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[d] Construct new Pu and HEU facilities.
[e] Net waste from new facility and from phaseout of existing facility.
Note: NA=not applicable.

Table S.8–5. Maximum Annual Net Incremental Volume of Solid Hazardous Waste Over No Action Generated During Operations at Each Candidate Site

Site	Waste Generated in 2005 (m^3)	Upgrade (m^3)	Consolidation (m^3)	Collocation (m^3)	Preferred Alternative (m^3)
Hanford	560	4	2	2	0
NTS	212	NA	2	2	0
INEL	1,200	1	2	2	0
Pantex	31	2[a]	2	2	1.5[b]
ORR	26	0.8[c]	[d]	2[e]	0.8
SRS	15,100	0.8[a]	2	2	0.6[f]

[a] Upgrade with RFETS and LANL materials.
[b] Upgrade with pits from RFETS.
[c] Total of mixed LLW and hazardous waste because hazardous waste is included in mixed LLW.
[d] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
[e] Construct new Pu and HEU facilities.
[f] Upgrade with non-pit materials from RFETS.
Note: NA=not applicable.

Table S.8–6. Maximum Latent Cancer Fatalities Over No Action for Maximally Exposed Individual for 50 Years From Normal Operations at Each Candidate Site

Site	No Action in 2005	Upgrade	Consolidation	Collocation	Preferred Alternative
Hanford	$1.0x10^{-8}$	$4.5x10^{-11}$	$6.2x10^{-11}$	$6.2x10^{-11}$	0
NTS	$1.0x10^{-7}$	NA	$1.4x10^{-10}$	$1.4x10^{-10}$	0
INEL	$4.4x10^{-7}$	$1.3x10^{-11}$	$4.0x10^{-11}$	$4.0x10^{-11}$	0
Pantex	$1.5x10^{-9}$	$4.5x10^{-13}$	$2.4x10^{-10}$	$2.4x10^{-10}$	$4.5x10^{-13}$
ORR	$3.5x10^{-8}$	$5.5x10^{-13}$	[a]	$1.1x10^{-9}$	$5.5x10^{-13}$
SRS	$2.0x10^{-5}$	$2.1x10^{-10}$	$3.5x10^{-10}$	$3.5x10^{-10}$	$2.1x10^{-10}$

[a] Since HEU is currently stored at ORR, the Consolidation and Collocation Alternatives would be the same.
Note: NA=not applicable.

Potential accidents were postulated for each of the long-term storage alternatives. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the accident scenario evaluated with the highest risk (PCV penetration by corrosion) for the Upgrade Alternative would be: $4.3x10^{-4}$ at Hanford; $1.6x10^{-3}$ at INEL; $8.8x10^{-4}$ at Pantex (Preferred Alternative); $3.0x10^{-5}$ at ORR (Preferred Alternative); and $4.6x10^{-4}$ at SRS. For both the Consolidation and Collocation Alternatives, the highest risk to the population located within 80 km (50 mi) of the accident release point associated with the accident scenarios evaluated (PCV penetration by corrosion) would be: $4.2x10^{-3}$ at Hanford; $5.1x10^{-5}$/$9.4x10^{-5}$ at NTS (P-Tunnel/New Pu and HEU Facility); $1.2x10^{-3}$ at INEL; $1.4x10^{-3}$ at Pantex; and $1.7x10^{-2}$ at ORR; and $4.6x10^{-3}$ at SRS. Since Pu accidents dominate the accident spectrum, the risks would be higher for the Consolidation and Collocation Alternatives because these alternatives would require more Pu at a single DOE site than the Upgrade Alternative.

Intersite Transportation. For intersite transportation, the Upgrade and Preferred Alternatives would have lower potential for fatalities. For the Preferred Alternative, the number of potential fatalities ranges from 0 at Hanford and INEL (since there is no transport of material) to 0.06 at SRS. The Consolidation and Collocation Alternatives would have the higher potential for intersite transportation fatalities because they would move the greatest amount of material between sites. The number of potential fatalities ranges from 0.079 (Consolidated Storage Alternative at Pantex) to 1.07 (Collocated Storage Alternative at Hanford). Intersite transportation impacts would primarily result from nonradiological sources, such as fatalities from nonradiological traffic accidents.

DISPOSITION ALTERNATIVES

Table S.8–7 depicts total campaign data for the disposition alternatives including the Preferred Alternative for disposition. A total of approximately 50 t (55.1 tons) of surplus Pu is assumed to be processed over the life of the campaign. In preparation for disposition under any alternative, surplus Pu must be processed through either the pit disassembly/conversion facility or the Pu conversion facility. Approximately 32.5 t (35.8 tons) are assumed to be processed at the pit disassembly/conversion facility, and approximately 17.5 t (19.3 tons) at the Pu conversion facility. Since these two facilities produce the input material for the other disposition facilities, actions at these two facilities would be the first to occur for the campaign. The operating period for these two facilities for each disposition alternative, including the Preferred Alternative, is 10 years.

Table S.8–7. Total Campaign Data (Approximate) for Disposition Alternatives and the Preferred Alternative

	Disposition Alternatives			Preferred Alternative		
Action	**Total Pu (t)**	**Throughput (t/yr)**	**Years In Operation**	**Total Pu (t)**	**Throughput (t/yr)**	**Years In Operation**
Pit disassembly/ conversion	32.5	3.25	10	32.5	3.25	10
Pu conversion	17.5	1.75	10	17.5	1.75	10
Direct to borehole	50	5	10	NA	NA	NA
Immobilized to borehole	50	5	10	NA	NA	NA
Vitrification	50	5	10	17.5[a]	5[a]	3.5[a]
Ceramic immobilization	50	5	10	17.5[a]	5[a]	3.5[a]
Electrometallurgical treatment	50	5	10	NA	NA	NA
MOX fuel fabrication	50	3	17	32.5	3	11
5 Existing LWRs[b]	50	3	17	32.5	3	11
2 Partially completed LWRs[c]	50	3	17	NA	NA	NA
2 Large or 4 small evolutionary LWRs	50	3	17	NA	NA	NA
CANDU reactors[d]	50	3.8	13	NA	NA	NA

[a] Either vitrification or ceramic immobilization would be implemented for immobilization of surplus Pu under the Preferred Alternative, but not both.
[b] Three to five existing LWRs would be used depending upon the amount of MOX fuel in the reactor core.
[c] If the partially completed LWRs were to be completed by other parties, they would be considered existing LWRs and could compete for the surplus Pu disposition mission under the Preferred Alternative.
[d] The CANDU reactor is retained in the event a multilateral agreement is made among Russia, Canada, and the United States to use CANDU reactors.
Note: NA=not applicable.

The operation of the disposition facilities for a single disposition alternative would require between 10 and 17 years to accomplish the disposition mission. However, the Preferred Alternative may result in fewer years of operation for the disposition facilities, since the 50 t (55.1 tons) of surplus Pu would be dispositioned under two different technologies. For purposes of analysis, it is assumed that approximately 17.5 t (19.3 tons) of surplus Pu would be immobilized through vitrification or ceramic immobilization, and approximately 32.5 t (35.8 tons) would be converted to MOX fuel for use in reactors,[20] under the Preferred Alternative. The number of years in

[20] The actual amount dispositioned under each disposition technology would depend on subsequent NEPA analysis, costs, test and demonstration results, international agreements, and the procurement process among other things.

operation for each disposition technology may be less than that required to process the full 50 t (55.1 tons) with any single disposition alternative.

Actual years of operation and Pu throughput rates for any of the reactor disposition alternatives would not exceed 17 years and 3.8 t/yr (4.2 tons/yr), respectively, but could be less depending upon the final reactor core design. Variables such as the amount of MOX fuel included in each core have not yet been determined and would affect the years required to complete the mission using the reactor alternatives. Conservative estimates for throughput and years in operation are presented for comparing the Reactor Alternatives with the Preferred Alternative.

Table S.8–8 presents a comparison of the total campaign impacts from the disposition of 50 t (55.1 tons) of surplus Pu for key environmental resources for the individual disposition alternatives and the Preferred Alternative. Since the ceramic immobilization facility generally has greater impacts than the vitrification facility, it was used in the calculation of the total campaign impacts for the Preferred Alternative. A comparison of impacts is not included for community services, environmental justice, and noise since the impacts are highly site-specific.

Biological, Geology and Soil, Land Use, and Cultural and Paleontological Resources. Ground disturbance during construction activities would potentially impact soil; biological; cultural resources (including historic, prehistoric, and Native American); and paleontological resources for all of the disposition alternatives. The immobilization alternatives would disturb the least amount of land while the Evolutionary LWR Alternative would disturb the most land area because it would require the most new construction. However, when considering operational land area, the two Deep Borehole Alternatives would require the most land because of the 1.6-km (1-mi) radius buffer zone. Depending upon location, all of the alternatives could result in visual resource impacts by changing the visual resource management classification of an area. The Deep Borehole Alternatives would impact geologic resources because the borehole operations would render the site perpetually unusable.

Site Infrastructure and Water Resources. The evolutionary LWR would require the largest electrical load during operations. The Evolutionary LWR and the Partially Completed LWR Alternatives would require the most additional water for operations. The rest of the alternatives would require nearly the same amount of water, with the exception of the Electrometallurgical Treatment Alternative, which would require the least amount of water.

Air Quality and Socioeconomics. Potential construction-related impacts on air quality and local transportation would be minor for all of the disposition alternatives and the Preferred Alternative. The Evolutionary LWR and Partially Completed LWR Alternatives would generate the most employment and income among the alternatives. For local transportation, the Evolutionary LWR Alternative would have the greatest potential of reducing the level of service on local roads during construction and/or operations. Some reduction in level of service would also be expected for the Vitrification, Ceramic Immobilization, and the Preferred Alternatives.

Public and Occupational Health and Safety. There would be potential for impacts to public and occupational health and safety from the radiological and hazardous chemical doses during operations of all the disposition alternatives, including the Preferred Alternative; however, the annual radiological doses to onsite workers and the public would be within regulatory limits for all alternatives. For hazardous chemicals, potential impacts to the public and onsite workers would not be expected to cause adverse health affects.

A set of potential accidents was postulated for each of the disposition technology alternatives. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the front-end disposition process campaign would range from 4.5×10^{-16} to 1.7×10^{-4} for pit disassembly/conversion (for the highest accident risk scenario [fire on loading dock] at the potential disposition sites: 4.6×10^{-5} at Hanford; 1.4×10^{-5} at INEL; 1.6×10^{-5} at Pantex; and 5.0×10^{-5} at SRS) and from 1.5×10^{-16} to 1.3×10^{-4} for Pu conversion

Table S.8–8. Comparison of Resource Use and Impacts From the Total Campaign for the Operation of Disposition Alternatives[a]

Alternatives	Total Number of Worker-Years	Water Usage (million l)	Latent Cancer Fatalities for MEI from Lifetime Accident-Free Operation	Solid TRU Waste Generated (m^3)	Solid Low-Level Waste Generated (m^3)	Solid Hazardous Waste Generated (m^3)
Direct to borehole	20,550	3,405	$1.2x10^{-9}$ to $1.2x10^{-7}$	3,452	18,500	287
Immobilized to borehole	29,550	6,605	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,955	18,740	497
Vitrification	24,810	4,251	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,440	18,590	307
Ceramic immobilization	25,730	4,251	$1.2x10^{-9}$ to $1.2x10^{-7}$	4,440	18,590	307
Electrometallurgical treatment	17,960	1,751	$1.2x10^{-9}$ to $1.3x10^{-7}$	3,510	19,000	125
5 Existing LWRs[b]	29,030	2,717	$1.3x10^{-6}$ to $2.6x10^{-6}$	8,652	21,051	2,718
2 Partially completed LWRs[c]	47,305	2,352,000	$9.8x10^{-6}$ to $9.9x10^{-6}$	8,652	22,955 to 42,709	3,636
2 Evolutionary large LWRs[d]	53,850	2,062,000	$5.8x10^{-7}$ to $8.2x10^{-5}$	8,652	38,051	3,636
4 Evolutionary small LWRs[e]	59,630	1,856,000	$8.4x10^{-7}$ to $9.6x10^{-5}$	8,652	39,411	4,554
CANDU reactors[f]	25,630	2,717	$1.8x10^{-9}$ to $1.2x10^{-7}$	8,652	21,051	2,718
Preferred Alternative[g]	16,140	3,253	$9.0x10^{-7}$ to $1.7x10^{-6}$	7,163	20,182	1,866

[a] Data includes all front-end processes (Pu conversion, pit disassembly/conversion, and MOX fuel fabrication) that would be needed for the individual alternatives. The total campaign impacts were calculated by multiplying the annual impacts times the number of years of operation, as identified in Table S.8–7.
[b] The table reflects the use of 5 existing LWRs. Three to five existing LWRs would be used depending upon the amount of MOX fuel in the reactor core.
[c] The table reflects the use of 2 partially completed LWRs.
[d] The table reflects the use of 2 evolutionary large LWRs.
[e] The table reflects the use of 4 evolutionary small LWRs.
[f] The table reflects impacts from pit disassembly/conversion and MOX fuel fabrication in the United States.
[g] Ceramic immobilization and 5 existing LWRs are the assumed technologies for the Preferred Alternative for comparative purposes only.

(for the highest accident risk scenario [fire on loading dock] at the potential disposition sites: $3.5x10^{-5}$ at Hanford and $3.2x10^{-5}$ at SRS). Within the borehole category, the risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for direct disposition campaign would range from $8.4x10^{-16}$ to $6.3x10^{-8}$. For both the ceramic immobilization front-end process prior to immobilized disposal, and ultimate disposition in the deep borehole complex, the risks would range from $9.3x10^{-18}$ to $6.3x10^{-8}$ and $9.3x10^{-19}$ to $6.3x10^{-9}$, respectively for the disposition campaign. The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the immobilization category would range from $2.8x10^{-14}$ to $1.8x10^{-5}$ for the vitrification alternative and from $7.0x10^{-16}$ to $1.9x10^{-7}$ for the ceramic immobilization alternative over the disposition campaign (for the highest accident scenario [criticality] at the potential disposition sites and 30 percent immobilization campaign: $1.7x10^{-8}$ at Hanford and $2.1x10^{-8}$ at SRS). For the immobilization of Pu through electrometallurgical treatment of spent fuels, the projected campaign risk to the population would be $3.5x10^{-7}$ for the accident scenario evaluated with the highest risk (a breach in the argon cell initiated by a design basis earthquake).

For the reactor alternative, the risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the MOX fuel fabrication facility would range from $4.6x10^{-16}$ to $4.3x10^{-4}$ for the campaign (for the highest accident scenario [fire on loading dock] at the potential disposition sites using for analysis purposes, approximately 70 percent disposition campaign: $5.2x10^{-5}$ at Hanford; $1.6x10^{-5}$ at INEL; $1.8x10^{-5}$ at Pantex; and $5.2x10^{-5}$ at SRS). The risk of cancer fatalities to the population located within 80 km (50 mi) of the accident release point for the MOX-fueled evolutionary LWR would range from $9.6x10^{-11}$ to $6.9x10^{-6}$. Under the Preferred Alternative, DOE would pursue the use of MOX-fueled LWRs. The incremental effects of utilizing MOX fuel in a reactor in place of UO_2 were derived from a quantitative analysis of severe accident release scenarios for MOX and UO_2 using the MACCS computer code and generic population and meteorology data. The analysis only considers severe accidents where sufficient damage would occur to cause the release of Pu or uranium. The risks of severe accidents were found to be in the range of plus 8 to minus 7 percent, compared to UO_2 fuel, depending on the accident release scenario. The incremental risk of cancer fatalities to a generic population located within 80 km (50 mi) of the severe accident release point would range from $-2.0x10^{-4}$ to $3.0x10^{-5}$ per year.

Waste Management. The reactor alternatives and the Preferred Alternative would be the only alternatives that would generate spent nuclear fuel. The Partially Completed LWR Alternative would generate the largest incremental increase in spent nuclear fuel. The Preferred Alternative would generate the lowest incremental increase of spent nuclear fuel among the reactor alternatives because the combination of disposition technologies would require less Pu to go through reactors. The reactor alternatives and the Preferred Alternative would also generate the most solid TRU, solid low-level, and solid hazardous waste among the alternatives.

Intersite Transportation. The Evolutionary LWR and Partially Completed LWR Alternatives would have the highest potential fatalities over the total campaign because they would require the most material transport. The Preferred Alternative and Electrometallurgical Treatment Alternative would have the lowest potential fatalities from transportation. Intersite transportation impacts would primarily be the result of nonradiological impacts such as fatalities from nonradiological highway accidents.

S.9 SUMMARY OF MAJOR ISSUES IDENTIFIED DURING THE COMMENT PERIOD AND CHANGES TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

S.9.1 ISSUES IDENTIFIED AND RESOLVED

The Department initially issued the Storage and Disposition PEIS as a draft for public comment for the period from March 8 through May 7, 1996. In response to public requests, DOE extended the comment period deadline to June 7, 1996. Public meetings on the Draft PEIS were held in March and April 1996 at the following locations:

Denver, CO	March 26, 1996
Las Vegas, NV	March 28–29, 1996
Oak Ridge, TN	April 2, 1996
Richland, WA	April 11, 1996

Idaho Falls, ID	April 15, 1996
Washington, DC	April 17–18, 1996
Amarillo, TX	April 22–23, 1996
North Augusta, SC	April 30, 1996

During the 92-day public comment period on the Storage and Disposition Draft PEIS, DOE received comments on the document by mail, fax, telephone recording, electronic mail, and orally at the public meetings. Altogether, DOE received approximately 8,700 written and recorded comments from individuals and organizations. All comments are presented in Volume IV of the Storage and Disposition Final PEIS, the *Comment Response Document.*

Approximately 80 percent of the comments received consisted of mail-in letter and postcard campaigns which expressed either support of or opposition to the use of various sites or alternatives. Many commentors encouraged DOE and the United States to become the world leader in the safe, secure, and timely disposition of Pu, and favored worldwide nonproliferation efforts for surplus Pu. The following highlights recurring comments, DOE's response, and the PEIS revisions in response to these comments.

A number of commentors expressed the opinion that the surplus Pu should remain in present locations for future energy or weapons use, or until new technologies are available for disposition. In response to these concerns, DOE expanded the discussion on the need for the proposed Pu disposition action in the PEIS. Disposition is necessary to implement the President's *Nonproliferation and Export Control Policy* in a safe, reliable, cost-effective, and timely manner.

Some commentors also stated that DOE should consider additional disposition alternatives, including the use of FFTF, deep burn reactors, and mononitride reactors. The use of advanced reactors such as deep burn reactors and mononitride reactors was considered but eliminated due to the technical immaturity, attendant costs, and lengthy development and demonstration efforts required to bring the technologies to a viable, practical status and enable disposition options to be initiated with certainty. The FFTF would be considered for Pu disposition if first selected for tritium production. The FFTF is not a reasonable, stand-alone alternative because it is in a standby status awaiting shutdown and because it could not satisfy the criterion of completing the disposition mission within 25 years. A discussion of FFTF for this purpose is included in Appendix N. In all, thirty-seven different alternative options were considered by DOE for disposition of Pu. DOE has made revisions to the Summary and Chapter 2 of the PEIS to clarify how the screening process was used for selection of reasonable alternatives.

Commentors noted that transportation of fissile materials is one of their major concerns with the Program. The ground transportation between sites, in the event a consolidation alternative was selected, could increase the potential for traffic accidents. International transportation for specific border crossings for the shipment of MOX fuel to Canada for the CANDU Reactor Alternative was also identified as a concern. DOE acknowledges the public's concern, and in response, the transportation analysis in Section 4.4 and Appendix G of the Draft PEIS was expanded. The revisions address security measures for land and sea transport, emergency preparedness, and clarify the results of analyses performed.

One frequently recurring comment presented by the public relates to the technical, cost, schedule, and nonproliferation analyses to support DOE's ROD. Many of the commentors suggested that DOE should make information available for public review. Since issuance of the Draft PEIS, DOE has prepared both the *Technical Summary Report for Long-Term Storage of Weapons-Usable Fissile Materials* (DOE/MD-0004 Rev. 1) and the *Technical Summary Report for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0003 Rev. 1). These two reports summarize representative technical, cost, and schedule data for the reasonable alternatives being considered for long-term storage and surplus Pu disposition, respectively. In July and August 1996, these documents were initially distributed for public review and comment. After taking the public's comments into consideration, DOE revised and re-issued both reports in November and December 1996. In October 1996, DOE issued the *Draft Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Material Storage and Plutonium Disposition Alternatives*, which analyzes the nonproliferation and arms reduction implications of the alternatives addressed in the PEIS for Pu and HEU storage and the disposition of surplus Pu. From October through early November 1996, the public was asked to review and comment on the draft nonproliferation document; this process included a series of 10 public meetings held nationwide. Public comments received are being taken into consideration in revising the report, which is scheduled for re-issue in late 1996. This report, in conjunction with the Final PEIS, the technical summary reports previously described, and public input, will form the basis for DOE's decisions, which will be discussed in a ROD to be issued no sooner than 30 days after publication of the Environmental Protection Agency's Notice of Availability of the Final PEIS.

Commentors also stated that the U.S. Nonproliferation Policy does not encourage the civil use of Pu or Pu processing for either nuclear power or nuclear explosive purposes. The commentors requested that the PEIS address the possibility that the MOX option would have an adverse effect on U.S. nonproliferation policy by encouraging its use in civil nuclear power programs and by encouraging Pu reprocessing and recycling. DOE acknowledges the public concern for nonproliferation. As discussed in the PEIS, the reactor option would utilize a once-through fuel cycle. Spent fuel from disposition would be disposed of with other commercial reactor spent fuel. This is consistent with U.S. policy since no Pu in the spent fuel would be recycled. Revisions to the Summary and Chapter 1 of the PEIS were made to expand and clarify this issue.

Commentors indicated that the isotopic composition of the residual Pu in the final waste forms is an inappropriate criterion by which to assess proliferation risks because it perpetuates a myth that reactor-grade Pu cannot be used to make workable weapons. In the opinion of these commentors, isotopic degradation does not constitute a compelling argument in favor of the MOX option. DOE acknowledges that, although it may be possible to make a nuclear weapon from spent commercial reactor fuel, this can only be done with extreme difficulty by individuals with a great deal of experience in handling and processing nuclear materials. DOE believes that the disposition of weapons Pu through the use of MOX fuel in reactors would meet the Spent Fuel Standard in creating a radiological barrier that makes the Pu as difficult to retrieve and reuse in weapons as Pu in spent commercial fuel. The use of this technology would allow for the Pu to be disposed in a geologic repository, the same as for spent commercial fuel. Revisions to Chapter 1 of the PEIS were made to clarify this issue.

S.9.2 CHANGES MADE TO THE DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

This section identifies changes made since the issuance of the Draft PEIS. The Final PEIS includes the Preferred Alternative, which is a combination of other alternatives and is described in Section S.2 and Section 1.6. Other changes, after considering public comments, are described below.

Appendix N, which in the Draft PEIS summarized the operational aspects of the multipurpose reactor, has been revised for the Final PEIS to provide information on the costs and benefits of conducting separate tritium production and Pu disposition missions versus the costs and benefits of carrying out one multipurpose mission. Included in Appendix N is a cost comparison of using new Advanced LWRs or Modular Helium Reactors, and a discussion of issues regarding the use of the FFTF (a liquid metal reactor at Hanford) for tritium production and Pu disposition.

Appendices O, P, Q, and R were added to the Final PEIS to help clarify alternative issues as they relate to the Preferred Alternative. Appendix O describes two can-in-canister technology concepts at SRS, which are variants of the Vitrification and Ceramic Immobilization Disposition Alternatives described in Chapter 2. This information was added based on public interest in these concepts during the Draft PEIS comment period, and also because of DOE's reconsideration of this technology as being a viable approach for Pu disposition through immobilization.

Appendix P provides a description of using the Manzano Weapons Storage Area (WSA) near Albuquerque, NM to store Pu pits. This appendix was added because DOE's Preferred Alternative separates the storage of pits from non-pit materials, in which case Manzano WSA no longer appears unreasonable under the Preferred Alternative for pit storage. However, since DOE's preferred site for interim storage of pits is Pantex (as described in the Pantex EIS) and since the majority of pits are already located in storage at Pantex, the Preferred Alternative proposes the long-term storage of Pu pits at Pantex. Weapons assembly/disassembly would continue at Pantex in any case. Construction of a new storage facility at Manzano would create needless expense and transportation risk.

Appendix Q describes the operations and human (radiological) health impacts associated with Pu pits being transferred from RFETS to Pantex, repackaged in Zone 12 South, and placed in storage in Zone 4 West at Pantex, as part of the Preferred Alternative for long-term storage. The information presented in this appendix is based on the Pantex EIS analysis of storing the Pu pits already at Pantex.

Appendix R discusses aircraft crash and radioactive release probabilities for proposed storage and disposition facilities at Pantex.

Section 1.2 of the Final PEIS has been revised to reflect the cooperative effort between the United States and Russia to study different options for managing excess Pu (including secure storage, conversion of Pu weapons components to other forms, and stabilization of unstable forms of Pu), and options for disposition of excess Pu (deep borehole, immobilization, and reactors). The results of this study have been documented in the *Joint United States/Russian Plutonium Disposition Study* report, completed in September 1996. This study and the options considered will provide decisionmakers from both countries with a set of jointly evaluated alternatives for Pu disposition and help build further trust and cooperation in the area of fissile material disposition.